RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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RADIOLOGY

A MONTHLY PUBLICATION DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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Henry Ford Hospital, Detroit 2, Mich.

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Wendell G. Scott, M.D.
Carman Lecturer, 1950

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The Development of Angiocardiography and Aortography

Carman Lecture[1]

WENDELL G. SCOTT, M.D.[2]

St. Louis, Mo.

THIS YEAR, 1950, MARKS the 75th anniversary of the birth of Russell Daniel Carman—his diamond anniversary. Previous biographers have given us little about the fifteen formative years of Carman's professional life spent in St. Louis; yet it was there that the shining facets of his character were cut. It was there that the qualities which gave him outstanding brilliance in the radiological world took shape—a searching mind that was never satisfied until the diagnosis was verified, a keen power to observe what he studied, a smooth functioning capacity and application for work, and a natural "knack" for the mechanics of radiography—all encompassed by the charm of a warm friendliness which those who knew him well called "lovable."

The story of how Carman came to St. Louis is told in a letter from Dr. Thomas C. Witherspoon (1), his friend, associate, and brother-in-law, in answer to my inquiry. Dr. Witherspoon was a well known St. Louis surgeon who later retired to Los Angeles, and from there, at the age of eighty-two he writes:

"As for Russell, I met him first in Butte, Montana, where his mother, Mrs. Oliver, lived. I practiced in Butte from December, 1889, to November, 1893. In 1893 I returned to St. Louis due to death in the family. About the last of the nineties, Mrs. Oliver wrote me concerning the study of medicine by Russell, asking if I would more or less take him in tow if she [brought] him to St. Louis. This I gladly promised to do. . . [At about the time of his graduation from the Marion Sims College of Medicine in 1901], I became interested in the Roentgen ray and obtained a machine for my office. While I had a smattering of facts about the new ray, I thought it wise to have someone with me who could devote much time to the acquiring of all the known facts. Carman had been a good student and showed aptitude for this. Accordingly, I asked him to help me, and advised a course at Johns Hopkins (under Dr. F. H. Baetger, who was then Professor of Orthopedic Surgery) to more fully equip him in the understanding of the new ray. This period of training (1901–1902) he took and for further advancement, at their advice, went to Dr. Leonard at Philadelphia. On his return to St. Louis he joined me and we worked together until November, 1906, when I returned to Butte. Mrs. Oliver bought my home and office at 4318 Olive

[1] Delivered before the Radiological Society of North America at the Thirty-sixth Annual Meeting, Chicago, Ill., Dec. 12, 1950.

[2] Associate Professor of Clinical Radiology, Washington University School of Medicine, St. Louis, Mo.

Fig. 1. Carman's home and office in St. Louis, 1906–13. Mrs. Oliver, Carman's mother, purchased this home and office from his brother-in-law, Dr. Thomas C. Witherspoon, with whom he was associated in the practice of medicine in 1906. Here Carman practised medicine and roentgenology until 1913, when he was called to the Mayo Clinic. It is a substantial building and the addition in front obviously served as his office.

Street and he moved into it. There he practiced medicine and roentgenology."

Figure 1 is a recent photograph of Carman's home in St. Louis.

That Carman had "what it takes" is recorded by his appointment in 1903 as Instructor in Surgery at St. Louis University Medical School, which had just been created through a merger with his alma mater. His proficiency in the use of the roentgen ray in diagnosis was rewarded in 1908 by an appointment as Instructor in Roentgenology, and a year later as Assistant Professor. During this period he met and began a life-long friendship and association with Dr. Albert Miller (2) who became his collaborator in the preparation of many of his scientific contributions.

The year 1910 brought Carman to the Washington University School of Medicine as Instructor in Surgery in charge of Actinography. There he met Dr. R. Walter Mills, who had just returned from studying in the European clinics of Haudek and Holzknecht and was busily engaged in applying their technic as well as developing his own in the roentgen diagnosis of gastro-intestinal disease. They became close friends, and it was Mills (2) who instilled in Carman a deep interest in gastroenterology.

Russell Carman had prepared well, and when the call came from the Mayo Clinic to head the Department of Roentgenology in 1913, he could accept the challenge. He set about to learn, to develop, to teach, and to master gastro-intestinal diagnosis by the roentgen ray and contrast media.

My selection for this lecture by your President and Board of Trustees denotes the passing of time in a significant way, for I am the first of Carman Lecturers who is too young radiologically to have known the man we revere tonight. Another generation of radiologists has come of age and our appreciation of Carman's work grows as we gain perspective. The concepts evolved by Carman and others of his era for the accurate employment of contrast media in the gastro-intestinal tract are so basic and sound that they can guide us in this decade in the use of contrast media for the exploration of the cavities of the heart and blood vessels. Indeed, I am highly honored to present before this great Society an evaluation of the developments in cardiovascular radiology pertaining to angiography.

* * * * * * * *

In the history of diagnostic roentgenology outstanding achievements have characterized each decade. In the "nineteens" it was the maturing of gastro-intestinal diagnosis; in the "twenties," the discovery and universal acceptance of cholecystography and intravenous urography, while the "thirties" brought the fruition of pneumoventriculography and encephalography. The "forties" saw the perfection of myelography, the application of miniature film and photofluorography for mass surveys, and, since the war, the expanded use of contrast media in the visualization of the heart and blood vessels, together

with the introduction of equipment for the rapid serialization of x-ray exposures. At the conclusion of World War II, the brilliant achievements in cardiac surgery by Gross and Hubbard (3), Blalock and Taussig (4), Potts, Smith, and Gibson (5), and others, created a need for better visualization of the types, location, and extent of cardiac malformations in order that they might be more accurately diagnosed and appraised for possible surgical correction.

Certainly, angiocardiography has provided a degree of accuracy in the diagnosis of congenital heart disease that was previously unattainable. Such an accomplishment was a gradual evolution which began twenty-seven years ago (1923), when Sicard and Forestier (6), exploring a new field for the use of their iodized poppyseed oil, slowly injected into the antecubital vein, at first of dogs and then of man, 4 c.c. of lipiodol and with the fluoroscope watched it flow through the right side of the heart into the pulmonary arteries and out to the capillaries. Berberich and Hirsch (7), a few months later, obtained the first angiograms of peripheral blood vessels and introduced halogen compounds as contrast media when they injected strontium bromide into the arteries and veins of the arm and hand. Brooks (8) in March of 1924, at Barnes Hospital in St. Louis, made the initial angiograms in this country by injecting for the first time a solution of 50 per cent sodium iodide into the femoral artery of a man under general anesthesia.

Before going on, this is a good time to explain how the percentage concentration of the solutions is expressed. All the commercial compounds are given in weight/volume percentages. That means, for example, that 50 per cent abrodil has 50 gm. of the chemical per each 100 c.c. of solution. The opaque solutions prepared by the investigators themselves are expressed in weight/weight percentages. For example, 50 per cent sodium iodide solution means that 100 gm. of sodium iodide is placed in a total of 100 c.c. of water.

Egas Moniz (9, 10), in 1927, by the dramatic visualization of the arterial system of the brain, his *l'encéphalographie artérielle*, with the aid of strontium bromide and later of sodium iodide, brought angiography into the spotlight. He focused attention on the possibility of using this method for the diagnostic exploration of an organ and inaugurated a new era in roentgenography. By April of 1929, surgeons dos Santos and Lamas, with the radiologist, Caldas (11), all of Lisbon, Portugal, had applied Moniz's method to peripheral arteriography and obtained satisfactory angiograms in various disorders of the lower extremities. At the same time they announced their method for the startling visualization of the abdominal aorta and its branches by insertion of a long needle through the left paravertebral region in the back to pierce the aorta, and injection directly into it of a concentrated solution of sodium iodide. This opened the door to the visualization of the arterial system within the abdomen.

In the same year, 1929, Forssmann (12) introduced a ureteral catheter into the antecubital vein of the arm and maneuvered it into the right auricle as a means of injecting drugs and infusions directly into the heart for emergency treatment in preference to direct intracardiac injections. Not until 1931 (13) did he conceive the idea of visualizing the chambers of the heart by the injection of sodium iodide, and later 50 per cent uroselectan, through his "heart-probe." He obtained satisfactory cardiograms of the chambers on the right side of the heart in dogs but was unsuccessful in two attempts made on himself.

The next year, 1931, Moniz, Carvalho, and Lima (14) made a long step forward by their announcement of *l'angiopneumographie*, an examination they had performed on animals and in man by injecting sodium iodide through a heart catheter and demonstrating it in the pulmonary arterial tree. They (15) thereby created a new method for the diagnostic radiography of the lungs and established the accurate interpretation of the hilar shadows and

lung markings. With a years experience they, with Saldanha (16), found that they could obtain the same results without the use of the catheter, by simply injecting the material directly into a cubital vein.

In 1933 bold attempts were made to visualize the chambers of the heart. The Italians, Conte and Costa (17, 18) tried without success to obtain greater opacification within the heart chambers by inserting two catheters into the right auricle, one through a vein of each arm, and injecting them simultaneously with 5 c.c. of 100 per cent abrodil to which had been added 1.0 gm. of sodium iodide. The amount was too little and the injection time too slow. Reboul and Racine (19) punctured the intact chest wall of the dog to enter the left ventricle, into which was injected 45 per cent tenebryl. They pictured it for the first time together with the aorta and the coronary arteries. Three years later Nuvoli (20) in Rome used this technic to pierce the left ventricle in one man and the ascending aorta in another to demonstrate aortic aneurysms. Ameuille and associates (21), reverting to the heart catheter, demonstrated the right auricle and ventricle in a man with a dextrocardia to obtain the first pneumoangiogram in a patient with a congenital cardiac anomaly.

To Castellanos, Pereiras, and Garcia (22, 23) great credit is due for their studies, published in September 1937, on *La angiocardiografia radio-opaca*. Beyond doubt they were the first to report the successful application of angiocardiography, the name they gave the procedure, as a diagnostic method of clinical value in infants and children under six years of age with congenital heart malformations, chiefly septal defects. The Cuban pediatricians succeeded because they pioneered (*a*) the use of a large needle, actually a Lindemann trocar, (*b*) the fast emptying syringe, "of a sufficiently great interior diameter so that a strong push on the plunger permits the whole quantity to be injected in a short time," and (*c*) rapid injection, with an upper limit of one and one-half to two seconds. They were fortunate in working with children whose small size made possible the opacification of the heart and great vessels by the 50 per cent concentration of perabrodil then available. They did not succeed in larger children and did not attempt the procedure in adults but suggested the answer to their handling by writing: "Sr. Malvido, the representative of Bayer in Havana, has sent to Germany for more concentrated solutions up to 70 per cent, which probably will solve the problem." The illustrations contained in their publications do not show the chambers in the left side of the heart except in subjects with septal defects.

The maturing of angiocardiography came with the publication in 1938 of the remarkable work by Robb and Steinberg (24) in which they announced that they had succeeded in visualizing for the first time all the chambers of the heart and aorta. Robb (25–28) had prepared himself for this major contribution by working with the brilliant Soma Weiss from 1930 to 1933 in clinical investigations of the hemodynamics of cardiac and pulmonary circulation. Robb had gained wide experience in the determination of the circulation time and had used, among other testing agents, brilliant vital red dye, which he found passed through the heart and lungs in a high concentration. This led him to believe that an adequate concentration of a substance opaque to x-rays would similarly pass *en masse* through the heart and great vessels following peripheral intravenous injection. As early as 1933 he (29) had attempted opacification of the heart and great vessels by having an intravenous injection of 35 per cent uroselectan made on himself and observed fluoroscopically by Dr. Magnus Smedal at the Boston City Hospital. During the years 1935–36 he formulated his method (30, 31) independently of the Cuban workers. It included: (*a*) a 70 per cent concentration of skiodan and later diodrast, which he obtained by boiling down a 35 per cent solution (32), (*b*) a large needle with the syringe tip increased to the same diameter, (*c*) a drawing of venous blood to overlie and

flush the opaque solution through the arm veins, (*d*) having the subject inspire during the injection, and (*e*) a determination of the circulation time by ether and cyanide measurements to permit the opacification of selected heart chambers and vessels to coincide with the radiographic exposures. A little later he also advocated the elevation of the arm during the injection, to hasten the flow of the opaque medium, and the erect position for obtaining clearer lung fields. During 1936–37, with the assistance of Steinberg (33), he made angiocardiography a workable diagnostic procedure of great value for adults and older children, normal and abnormal. It is a tribute to these two workers that with minor modifications their technic has remained the accepted method for adults.

Since World War II the developments in angiocardiography have been largely directed toward the perfection of radiographic and accessory equipment for the rapid automatic serialization of x-ray exposures with the comprehensive demonstration of all the heart chambers and great vessels. The achievement of this goal will further minimize the hazard of repeated injections and re-examinations. Apparatus of this type will make more feasible the handling of infants and children who cannot cooperate but who derive the greatest benefit from an accurate diagnosis and appraisal of the cardiac status for possible surgical rehabilitation.

CONTRAST MEDIA

Today the choice of opaque solutions is limited to 70 per cent diodrast, 75 per cent neo-iopax, and 70 per cent urokon[3], none of which can be used with impunity, all of which are hypertonic and irritating to the endothelium of the vessels and cause some degree of discomfort. Pendergrass and associates (34), in a survey of the unfavorable reactions following the intravenous injection of diodrast for urography, reported a mortality rate of 0.0038 per cent. From the literature, Furman (35) collected 10 deaths following angiocardiography and Dotter and Jackson (36) in a recent questionnaire gathered 26 more, representing an incidence of 0.38 per cent. Morgan (37), in a series of over 600 injections, had a mortality of 1.0 per cent. Two of the patients died approximately thirty minutes after the intravenous administration of a test dose of 1.0 c.c. of 70 per cent diodrast, not from an allergic reaction but apparently from the respiratory embarrassment engendered by the excitement attending preparation for the procedure. This experience stresses the need for maintaining a quiet, calm atmosphere in the radiographic room and the value of mild sedation. We have had 2 deaths in over 200 injections, a mortality of 1.0 per cent. One followed angiocardiography and the other retrograde aortography. Both fatalities occurred immediately after the injection and were due to respiratory and cardiac arrest. One patient was an infant who had received two injections, and the other an infant who was in critical condition and on whom the examination was performed in a desperate attempt to determine if surgical measures could help. Both children were cyanotic. The value of a preliminary intravenous test dose of 1.0 c.c. of the opaque solution is uncertain. We consider it useful and have used it many times. In one instance it produced a temporary coma and bradycardia of sufficient severity for us to abandon the examination. The important point, as is shown in Table I, is that the mortality rate for intravenous urography is 0.0038 per cent and is stepped up a hundredfold by angiocardiography in children, to 0.38 per cent.

Gordon and associates (38), working with dogs, report that the "diodrast reaction" consisted of: an initial rise in blood pressure with a subsequent fall; a rise in pulse pressure with significant changes in the contour of the femoral pulse; a rise in the venous pressure; a slowing of the pulse rate; changes in the electrocardiograph, and death from cardiac and pulmonary arrest. The reaction is caused in part by the drug itself and in part by such factors as the

[3] Urokon sodium, 70 per cent (w/v) at present limited to investigational use.

TABLE I: DEATHS FOLLOWING INJECTION OF DIODRAST FOR UROGRAPHY AND ANGIOCARDIOGRAPHY

Author	No. Examinations	Medium	Procedure	Deaths
Pendergrass *et al.*	661,800	Diodrast, 30%	"IV" Urography	26(0.0038%)
Dotter	6,824	Diodrast, 70%	"IV" Angiography	26(0.38%)
Morgan	600	Diodrast, 70%	"IV" Angiography	6(1.0%)
Scott	200	Diodrast, 70%	"IV" Angiography	1 } (1.0%)
		Diodrast, 35%	Retrograde Aortography	1 }

The fatalities following intravenous injection of 35 per cent diodrast for urography amount to 0.0038 per cent, while in a large series of intravenous injections of 70 per cent diodrast for angiocardiography the incidence is 0.38 per cent, an increase of approximately one hundred fold. The greater risk in angiocardiography is due largely to the hazards of working with debilitated and cyanotic children and infants with cardiac malformations and also to the amount and higher concentration of the diodrast.

amount of fluid injected, its concentration, osmotic pressure, and viscosity, and the speed of injection. The rapid injection of a large amount of fluid alone did not produce the reaction. Its severity, however, was influenced by the speed of the injection and the concentration of the fluid. No evidence was obtained that hypersensitivity or anaphylactoid reactions were involved. Nothing of significance was found in the postmortem examination of the animals.

These reports and investigations mean, first, that the patients subjected to angiocardiography must be selected with greater discrimination, by eliminating those with renal complications and those who are extremely debilitated. Second, present preliminary tests for hypersensitivity to the drugs do not foretell the fatality that may follow and, therefore, must be redesigned for the detection of a non-allergic susceptibility, probably by physiologic measurements of the pulse, blood pressure, and respiration. Third, smaller amounts of contrast media must be used in infants and children, particularly in those with cyanosis and a suspected pulmonary stenosis. Fourth, repeated injections due to failures or for obtaining different projections should not be performed in close sequence and, if possible, should be avoided altogether. These four points may well serve as illustrating the contraindications to angiographic procedures.

RADIOGRAPHIC EQUIPMENT FOR ANGIOCARDIOGRAPHY

Carman's (39) statement on apparatus for the radiography of the digestive tract applies to that for angiocardiography. To quote: "An adequate equipment for roentgen apparatus simplifies and facilitates the examination . . . [and] can hardly be dispensed with. It is true that in this, as in many other things, the man counts for more than the machine, and . . . the bulk of roentgenologic knowledge has been gained by those who had to content themselves with crude appliances. Yet modern apparatus saves time and labor, invites thoroughness and lessens the chance of error."

Nearly everyone who has had experience with angiocardiography has found it necessary to modify or to develop his own equipment to obtain fast serialized radiographic exposures. It is beyond our time limits to describe each one. In general, there are three basic types of apparatus: (1) those for photofluorography with the cine or modified miniature camera; (2) those for fast continuous changing of cassettes, and (3) those for rapid direct radiography on large roll film.

Photofluorography: Cineroentgenography, by which the fluoroscopic image of the opacified chambers of the heart and great vessels is photographed with a 16-mm. cine-camera, was introduced by Stewart and associates (40) in 1939. They reported additional studies (41) on congenital and acquired heart disease by this method in 1941. At that time, Sussman and associates (42) were having difficulty in establishing the exact timing of exposures to coincide with the moment of opacification of the desired chambers of the heart and great vessels. To obviate this problem, they

tried cinephotofluorography on 16-mm. film, but gave it up in preference for 35-mm. film, which they exposed in a Robot camera, and later in a Leica, at the rate of two frames per second. Temple and colleagues (43), in 1948, seeking the advantages of a larger picture, accelerated the transport of the 70-mm. film in a Fairchild photofluoroscopic camera and attained a rate of one frame per second. Watson and

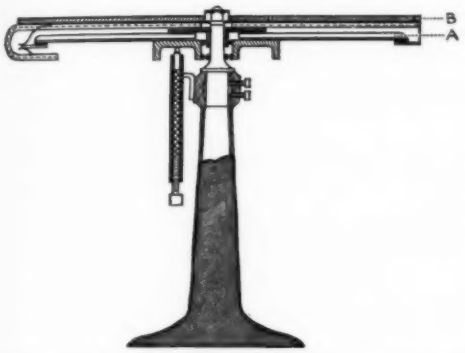

Fig. 2. The first of the cassette changers, the *radio-carrousel* of Pereira Caldas. This was in use by Pereira Caldas in 1933. It consisted of a large metal wheel, A, in which six 24 × 30-cm. cassettes were set in frames about the periphery. This round disk was covered by a sheet of lead, B, in which an exposure opening was cut. The cassettes were brought under the exposure opening in succession by manually rotating the wheel. X-ray exposures could be made at the rate of one per second.

Weinberg (44), also in 1948, improved the technic and quality of both 16- and 35-mm. cinephotofluorography. Furthermore, they reduced the amount of radiation received by the patient by synchronizing a lead shutter to interrupt the x-ray beam during the time occupied by the movement of the film. The patient thus received only that portion of the beam necessary to make the picture. Janker (45) in 1950 applied this method to the study of patients with congenital malformations of the heart.

These advances keep us aware of the promising potentialities of photofluorography; yet at this date the capital expense of the equipment remains too great, the radiation to the patient abundant if not excessive, and the proper viewing of the miniature film unsatisfactory without special equipment. In detail and quality

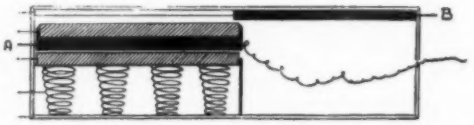

Fig. 3. The *escamoteur* of Egas Moniz, a manual cassette changer for two films. In 1934 Moniz had developed this equipment especially for cerebral angiography. After the first film was exposed, the lead tray, A, containing the cassette was pulled into the receiving bin and the second cassette was pushed up into position by the springs. A sheet of lead, B, covered the top of the *escamoteur* except for the exposure opening.

the small films do not equal those obtained by direct radiography. In spite of these limitations, the method is an important one. Allied to this group, and belonging to the near future, are the adaptations yet to come from the Schmidt camera and the instruments now being pioneered for the intensification of the fluoroscopic image. Even with the great increase in efficiency they will bring, we are still dealing with a moving image that must be preserved and recorded. In working with units of this type, one is viewing a fleeting picture of contrast medium in swift action, and the adage that "the hand is quicker than the eye" will be applicable to this situation.

Fast Continuous Cassette Changers: The cassette changers made their appearance in 1934, with the "radio-carrousel" of Pereira Caldas (46), the Portuguese radiologist, who worked with dos Santos and Moniz. It was a large wheel with six 24 × 30-cm. cassettes set in frames about the periphery between the spokes and is shown in Figure 2. It was covered by a sheet of lead in which an exposure opening was cut. The cassettes were rotated manually in succession beneath the exposure opening at a speed of one per second. The platform could be tilted at right angles for examinations in the erect position. Sussman's group (47) constructed a similar wheel for upright examinations (1942). Taylor (48) devised an electrically driven drum holding eight 14 × 17-inch cassettes (1949).

Egas Moniz was among the first to appreciate the value of fast continuous roentgen exposures. He reported on the use of the Caldas "carrousel" in 1933 (49) and by 1934 had developed his own *escamoteur*

(50), a manual cassette changer for two films (Fig. 3). In 1935 Sanchez-Perez spent a year studying with him on a fellowship and later came to this country, where he elaborated the principle of the *escamoteur* into a manually operated unit of four cassettes (51). With the assistance of Carter (52), he enlarged it to take six cassettes expose them within 0.5 second. It was used chiefly for cerebral angiography.

Of the many cassette changers that have been built by radiologists and others (54–58) to shift the cassettes through a tunnel, and activated by hand, gravity, springs, or motors, those developed by Feitelberg (59) and the group at Stanford University

Fig. 4. Axén and Lind developed the first radiographic table for exposing simultaneously standard cassettes in vertical and horizontal magazines. Ten cassettes, 12 × 12 inches, could be stored in each magazine. The films in each magazine were exposed simultaneously and at one-half second intervals. (From Axén and Lind: J. A. M. A. **143:** 540, June 10, 1950.)

and from this gradually evolved the present satisfactory electrically driven seriograph, automatically controlled and capable of shifting eight cassettes at intervals ranging from 0.5 to 2.0 seconds. Equipped with a stationary grid it has proved to be the most serviceable of the cassette changers manufactured in this country for both cerebral angiography and angiocardiography.

In 1936 Rencz (53) succeeded in constructing an apparatus *der Stereo-Arteriograph*, which utilized two x-ray tubes and could automatically shift two cassettes and

Medical School (60) were the only ones that achieved even limited distribution. In general, all these self-devised units have been useful in the hands of the inventors and in furthering the development of more refined units. The tautograph which we (Scott and Moore, 61, 62; Scott, 63) produced in 1948 was one of these. In it a motor-driven chain-conveyor system brought 11 × 14-inch cassettes from the magazine into filming position. For the first time, the shifting of the cassettes and the roentgen exposures were synchronized with a self-cocking grid and the whole

equipment fully automatized and controlled from a single push-button. Any number of cassettes could be exposed at the rate of one per second. The moving grid gave the resulting angiograms a clarity and contrast that had not been achieved before. Yet, like most cassette changers then available, this did not expose films fast enough, was large and cumbersome, and could not be adapted easily to existing equipment.

Axén and Lind (64, 65) of Stockholm developed in 1948 the first fast continuous cassette changer for taking radiographs in two planes at right angles to each other (Fig. 4). They used a feeding mechanism embodying a double helical screw and a knife bolt which runs along the screw and has two steel lugs which feed the cassettes in the horizontal and vertical magazines to the exposure fields. It had a capacity of ten 12 × 12-inch cassettes for each magazine and exposed them at half-second intervals.

At the same time Lind, Wegelius, and Fredzell (66), also working at the Norrtulls Hospital in Stockholm, determined to record the dynamics of the heart in children radiographically by visualizing all phases of one complete cardiac cycle from full diastole to maximum systole. To do this, they calculated that an exposure rate of 12 films per second would be required and an exposure time of 1/50 second would be necessary to catch the fleeting movements of the auricles. They constructed an apparatus to meet these requirements by using a revolving fly wheel with a steel arm to drive the top cassette from the magazine after exposure. Special lightweight cassettes were made of aluminum with a lead back.

They (67) soon found that simultaneous two-plane radiography was essential for three-dimensional measurements of the heart chambers and that the moment of the roentgen exposures had to be indicated and combined with synchronous electrocardiograms. An experimental machine to meet these requirements was built (Fig. 5). It had sixty $7^1/_2 \times 9^1/_2$-inch cassettes made of fiber paper in each magazine. A strong spring pressed the top cassette against a

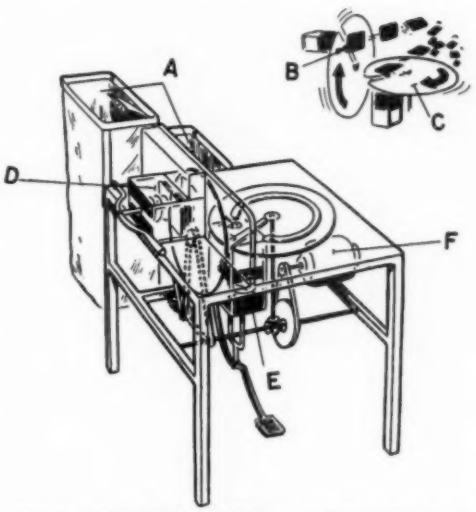

Fig. 5. Fredzell, Lind, Ohlson, and Wegelius made this unit for experimental studies in angiography of children. It exposed specially made small, light-weight cassettes with lead backs at the rate of twelve per second simultaneously in both the vertical and horizontal planes. A. Receiving bins for the exposed cassettes. B. Revolving steel disk with slot for moving cassettes from lateral magazine after exposure into receiving bins. C. Same mechanism as described in B for moving exposed cassettes from anteroposterior magazine. D and E. Spring assembly for pressing cassettes in magazines into position. F. Motor for turning drive shafts. (From Fredzell et al.: Am. J. Roentgenol. **63:** 551, April 1950).

rotating disk in which was cut a radial slit with the edge bent down the thickness of the cassette. With each revolution, the slit caught the upper cassette and placed it in a frame where it was held at rest, exposed, and then ejected by a spring wheel into the collecting bins. Stationary Lysholm cross-grids were used.

In 1950 Axén (68) brought out a newer model, in which he did away with all types of cassettes by securing the films to thin metal frames. This allowed the storage of forty 12 × 12-inch films in each of the double magazines. The frames were carried forward and exposed between intensifying screens at a maximum rate of five pairs per second, a rate which the Swedish group apparently concluded is satisfactory for clinical work. This model can be used only in the horizontal position.

Rapid Direct Radiography on Large Roll Film: The first apparatus for rapid direct radiography on large roll film, the cine-

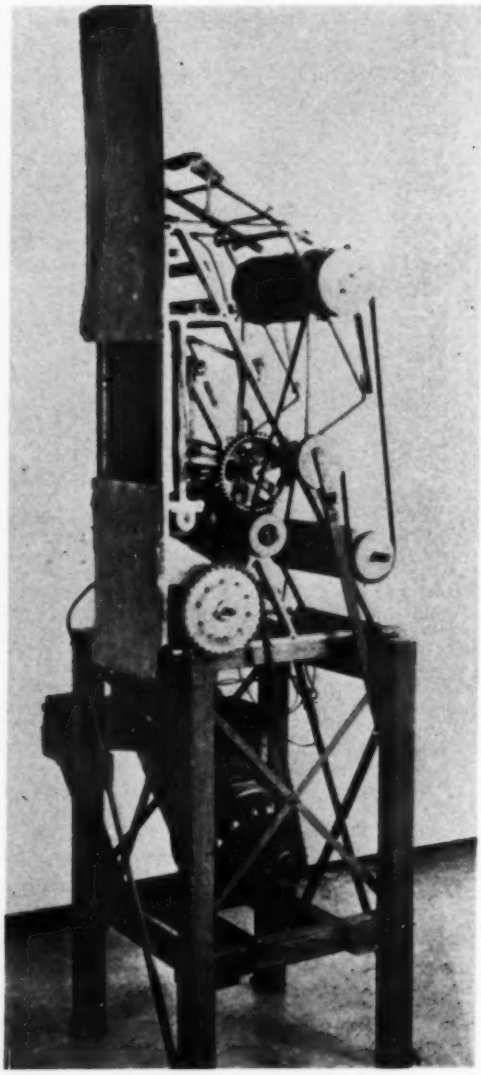

Fig. 6. The Ruggles cinematograph. The first apparatus for using a large roll film for rapid continuous x-ray exposures was devised by the late Dr. Howard Ruggles and was demonstrated before the Eleventh Annual Meeting of the Radiological Society of North America in 1925. It took fifteen 8 × 10-inch exposures per second on a strip of film 30 feet long. The mechanism was not enclosed and could therefore be operated only in a darkened room. This historic photograph was loaned for this presentation by Dr. W. Edward Chamberlain.

matograph, was devised by the late Dr. Howard Ruggles (69, 70), a member of this Society, and was demonstrated before the Eleventh Annual Meeting in 1925 (Fig. 6). It took fifteen 8 × 10-inch exposures per second on a strip of film 8 inches wide and 30 feet long, which was drawn through the exposure frame by rubber-covered rollers. Eccentric and connecting rods held the two intensifying screens apart and released brake shoes designed to prevent movement of the film during exposure. In 1929 Hans Jarre (71–73) produced his cinex-camera, utilizing roll film varying in widths from 5 to 10 inches. It was compact, practical in construction, manually operated at first to take four exposures per second and later by an electric motor. It did not have a Potter-Bucky or stationary grid. In 1938, van de Maele (74) constructed his apparatus, which could run at the surprising rate of sixteen exposures per second, but he states that a speed of six to eight was adequate for most purposes. The technical difficulties involved in the unwinding of large roll film and its fast transportation onto the take-up reel caused him to develop another machine employing the same basic features but using cut film, which he perforated along the borders. These films were stacked in the magazine and then singly brought out between intensifying screens, exposed, and retired.

The shortcomings of the tautograph and other cassette changers started me searching for another method, and I thought of the possibility of converting the magazine of the Fairchild A-5 Aerial Camera to this purpose. In January 1948 I arranged a meeting with Mr. C. E. Siebert of the Fairchild company in New York and he gave me a war surplus magazine. The story of its conversion has been published (Scott and Moore, 63, 75). Suffice it to say that after considerable effort and expense we achieved a successful unit and christened it the rapidograph (Fig. 7). The compact unit was mounted to the under side of a radiographic table in a way to permit the removal of the magazine for reloading. The roentgen exposure and the momentary stoppage of the film were synchronized with a fast self-cocking grid. The whole unit was automatized and, with the closing of one switch, a continuous

series of x-ray exposures could be made on 78 feet of film at half-second intervals, a speed nearly twice as great as that of most cassette changers of that period. If the syringe "stuck" or the injection was momentarily interrupted, the operator did not have to shut down, unload the exposed cassettes, reload them, and start over. An ample supply of film was in the rapidograph waiting for just such an emergency.

Louis to study it, and we turned our developments over to them. The manufactured model came out under the name "Roll Film Cassette." As with most new mechanical items, it had defects. With accumulated experience, the manufacturer has eliminated most of them and added improvements. The built-in sequencing device extends the useful diagnostic range of this equipment to other examinations

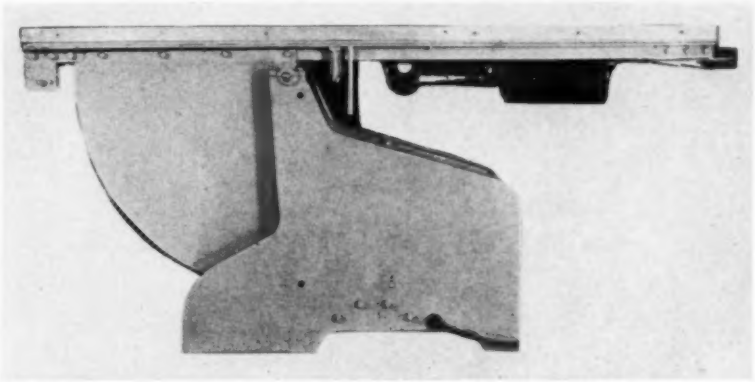

Fig. 7. The rapidograph, utilizing large roll film 9 1/2 inches wide and 78 feet long, for a continuous series of exposures at half-second intervals. It was constructed by taking the war surplus magazine of a Fairchild A-5 aerial camera and converting it for radiographic purposes by installing intensifying screens, by devising a new drive shaft, and by attaching it to a speed reducer motor. The story of the development of this equipment has been published elsewhere (75). The present roll-film cassette is the manufacturer's version of the rapidograph. The magazine and motor were mounted under the radiographic table in a manner to permit removal of the magazine to the darkroom for loading and unloading.

Being small and self-contained, the unit was flexible and could be mounted on existing tables, skull or sinus stands, or hydraulic bases, or could be used as a separate mobile table. We have often been asked why we selected a size $9^1/_2 \times 9^1/_2$ inches. The answer is that by not altering the frame of the magazine we could keep the costs down, production could begin at once, and supplies for the packaging of the $9^1/_2$-inch roll film were already available. In this project we received splendid cooperation from the manufacturers of x-ray films and grids.

A few weeks before we exhibited the rapidograph at the San Francisco meeting of this Society in December 1948 (76), the representatives of the Fairchild Camera and Instrument Company came to St.

which can be expedited by eliminating the handling of cassettes, such as serial filming of the stomach, pneumoventriculography, urography, and chest surveys. It provides a choice of either manual or automatic serial operation at time intervals from every half second to every three seconds, with full range of time exposures. The main disadvantage of the large roll film is the inconvenience of loading the magazine and of processing the long strips of film, especially in those departments which have been mechanized for cut film. Developing outfits (Fig. 8) are a help and can be inserted in the standard 10-gallon solution tank by the addition of supporting arms across the top.

While many of us were cognizant of the fact that the $9^1/_2 \times 9^1/_2$-inch exposure size

restricted the scope of the rapidograph, besides requiring careful positioning of the patient, Hodges and associates (77, 78) were the first to do something about it. They constructed a machine for making roentgenograms 11 × 11 inches at rates of two, four, or six per second on roll film.

With the completion of the rapidograph, it was obvious that it would be desirable to place two of them at right angles to each other to obtain simultaneous anteroposterior and lateral views. Morgan (37) assembled the first of these combined units, which included a sequencing device and was connected with an electrocardiograph. Within a few months I (79) had developed the second double unit and mounted it on an hydraulic base. Neither of these was entirely satisfactory, as the problems involved were more intricate than was apparent in the beginning. The motors on the two magazines were linked together by a series of rods and Boston gears to maintain them in the same phase to each other. In order to operate them from a single control, the exposures for the vertical and horizontal beams were alternated instead of set off at the same instant. With assistance from Dr. Hugh Wilson, the original model was improved by the construction of a heavier and stronger base to eliminate vibration and by mounting the magazines in fixed position, which we had learned from experience should be feasible (Fig. 9). Self-cocking grids with an 8 to 1 ratio were retained and are as effective as when used singly. The criss-cross grids were not necessary and, in fact, were a disadvantage because they required a third more radiation. Essential to the success of twin units was the coning of the x-ray beam to cover only the area to be radiographed. To date this is the first satisfactory double unit employing large roll film to be operated in this country. In this work we have used the same exposure factors as with the single unit, chiefly 300 to 500 ma., 60 to 95 kv., and 1/10 to 1/20 of a second. This technic is not practical with equipment of 200 ma. and 100 kv.

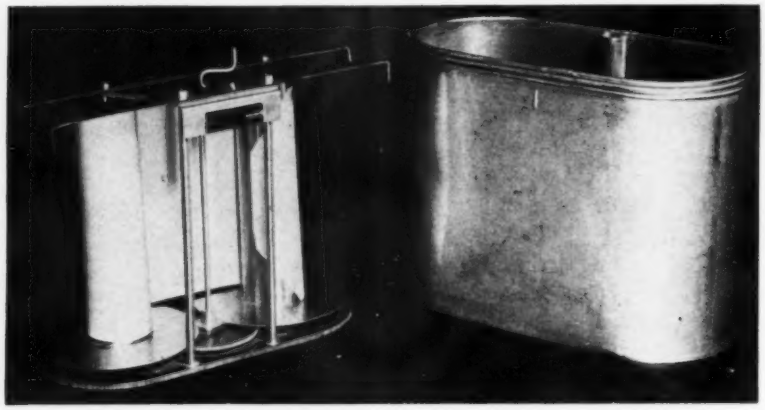

Fig. 8. Developing outfit for roll film. Automatic developing outfits are available for the processing of long strips of 9 1/2-inch roll film. Stainless steel bars can be placed across the top of these units, as shown in the photograph. They then may be suspended in conventional 10-gallon solution tanks. In this way it is not necessary to use the nested stainless steel tanks for the solutions. In actual work, our technicians prefer to develop these strips of film by hand in the regular darkroom tanks. In most instances the strips are not sufficiently long to warrant the time consumed in mounting them in the developing outfits. An electric motor fits on top of the crank between the spools and can be used for continuous operation.

The Chamberlains, Edward and Richard, with their dynamic imagination, and Hogan with his mechanical ingenuity (80) teamed up to bring out a twin unit of exceptional flexibility, with individual adjustments for each magazine, and readily

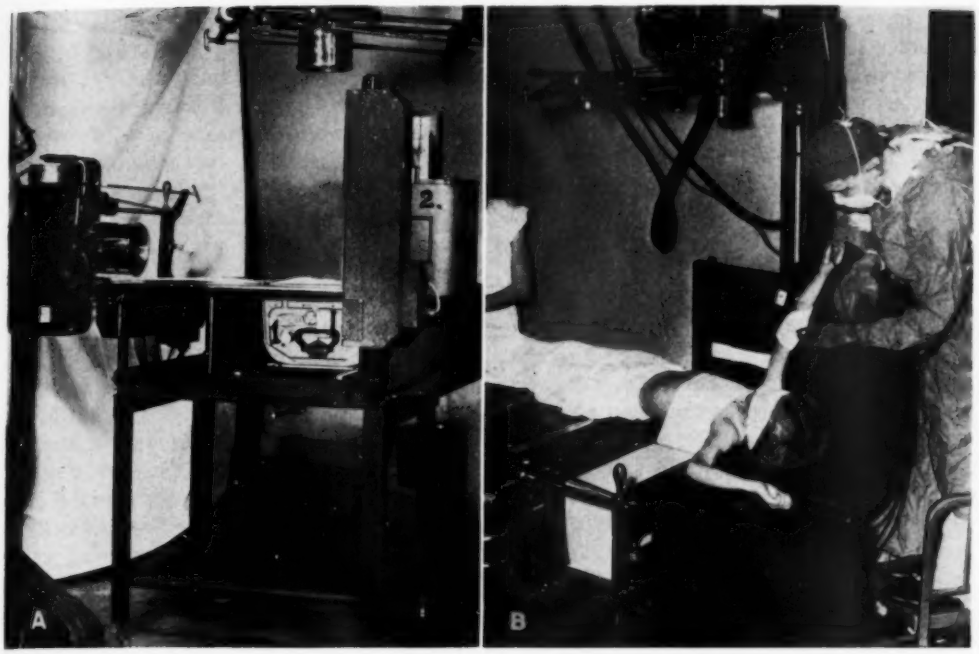

Fig. 9. The double or twin rapidograph for two-plane right-angle radiography following a single injection of contrast medium.

A. Two roll-film cassettes were mounted at right angles to each other on a solid four-leg stand. The original coupling device was replaced to permit an easier and a positive engagement of the magazine and motors. The two motors were connected by a series of rods and Boston gears so that they would always be 180° out of phase. In this way, a single control could be used and the exposures were alternated instead of being made simultaneously. Fast self-cocking Potter-Bucky grids were placed over the magazines to provide the greatest efficiency in the clean-up of secondary radiation. They have been more satisfactory than the criss-cross grids, which require nearly twice as much x-ray exposure. The x-ray beams must be collimated to the smallest possible diameter that will cover the radiographic field to reduce the scattering to a minimum.

B. A child in position for anteroposterior and lateral views following a single injection of contrast medium. A binder is stretched across the chest to immobilize the patient. A cannula has been inserted into an antecubital vein and connected to a two-way stop-cock so that saline can be fed into the vein until the moment of injection. One or two exposures are made on each magazine and then the opaque chemical is injected very quickly while the x-ray exposures are continued as long as is indicated by the particular case under study. In most instances the various chambers of the heart and the great vessels can be better visualized by placing the patient in a 45° posterior oblique position and getting the series of films in both right and left posterior oblique positions.

A heavy sheet of lead covers the back of the vertical magazine and grid assembly to protect the staff making the injection. A lead rubber sheet hangs between the physician and the x-ray beams at the head of the table to protect him from scattered radiation. It had been removed when this picture was made to avoid obscuring the details of the unit.

1. Magazine for anteroposterior series. 2. Magazine for lateral series.

rotated from the erect to the horizontal position. The x-ray tubes were mounted on rollers for making the exposures as a continuous stereoscopic series.

Gidlund's (81, 82) new apparatus takes two-plane radiographs 12 × 12 inches on larger roll film at four different exposure speeds up to eight per second. It is adaptable for vertical and horizontal examinations and embodies a fluorescent screen which can be used for positioning and for observing the movement of the contrast medium throughout the investigation. He also has developed a single unit which operates at the same speeds and has the advantage of using film 5, 12, or 28 inches in width but with the other dimension fixed at 10 inches. This equipment has yet to be tried in this country. In concluding the discussion of radiographic equipment, one cannot help but emphasize the tremendous evolution that has taken place since Caldas introduced his *radiocarrousel* just sixteen years ago.

Accessories: The performance of both high-speed cassette changers and large roll film apparatus requires certain accessories for proper functioning. The conventional x-ray timers and impulse timers are no longer adequate, for very few can recover quickly enough for fast continuous radiography at half-second intervals, and none at rates of five to ten per second or more. This means that timers employing electronic switching are essential.

Sequencing devices may be desirable but certainly are not essential. They range all the way from simple items to complicated machines. These devices afford a nicety in the spacing of exposures, permitting a series in rapid sequence during the opacification of pertinent chambers followed by delayed intermittent exposures of the remaining chambers. In this way they are an aid in economizing film consumption. Most x-ray technicians have had little or no experience with fast, continuously operating equipment and do not realize that an exposure of two or three seconds may consume 20 to 40 feet of film. The principal purpose served by sequencing devices, however, is to vary the interval of exposure and thus allow the equipment to be used for other radiographic examinations.

Manual and automatic pressure injectors for quick emptying of the syringe may be useful in angiographic technics. Nelson (83) in 1942, and later in the same year Doss (84), described equipment of this type for abdominal arteriography. Jönsson (85) also made a manually operated injector for use in retrograde arteriography through the right common carotid artery. All of these instruments were primarily constructed to hasten the speed of injection through needles or cannulas of relatively small diameter, usually about eighteen gauge. Morgan (37) devised an automatic injector for use in either cerebral or angiocardiographic examinations and recommends it for insuring a smooth injection at a uniform speed. It also provides protection from radiation to the operating personnel, who are no longer required to make the injection and to remain while the exposures are made.

To summarize: From this review of equipment for angiocardiography, certain trends are at once apparent. (*a*) Fast continuous radiography has become an accepted technic and is gaining widespread acceptance. (*b*) It can be satisfactorily accomplished both with fast cassette changers and with direct radiography on large roll film. The choice is a matter of personal selection, local requirements, and the particular demands of the staff. Each of the types of equipment has its own advantages and disadvantages. (*c*) Most are made as separate independent units and not as an accessory to a radiographic table. (*d*) For both cassette and roll-film roentgenograms a larger film size, approaching 12 × 12 inches, is favored, being more applicable to all types of angiographic examinations. (*e*) The minimum rate of exposure should be about two per second and the maximum about twelve, with most indications pointing to two to six as the most desirable. The higher speeds are for use in research studies. (*f*) The fast-recovering electronic thyrotron timers are essential. (*g*) The simple sequencing devices are convenient but not necessary for the control of the number and spacing of exposures in the different phases of the cardiac cycle. (*h*) Manually or automatically operated injectors are worth consideration as a means of avoiding exposure of the operating personnel, and also as a means of maintaining a steady injection of contrast medium. (*i*) The double or twin units for simultaneous right-angle radiography are advantageous and will come into general use in the larger centers to gain the safety and benefit of a comprehensive examination from a single injection.

Axén and Lind (65) cite the following advantages for synchronous radiography in two projections at right angles: (*a*) It aids in the precise identification of each anatomic section of the heart and great vessels. (*b*) It renders possible a three-dimensional study of the capacity and configuration of the separate chambers of the heart. (*c*) It

affords increased opportunities for the detection of abnormalities in the size or shape of the cavities and of abnormal communications between them. (*d*) It makes possible an estimate of the dynamics of the heart by recording the changes in the capacity of the heart chambers during the cardiac cycle. (*e*) It reduces re-examinations, which are laborious and time-consuming and which also complicate the interpretation, since it is virtually impossible to obtain a second series of films with the same degree of filling of the heart chambers in the same phase of the cardiac and respiratory cycles.

The advantages of fast serial radiography that are applicable to the single as well as the double units include: (*a*) the elimination of "guesstimating" the moment at which the roentgen exposures must be made; (*b*) the convenience of a series of films for checking the constancy of questionable filling defects; (*c*) the production of a continuous record of the passing of an opaque medium through a structure or organ from the beginning of the injection until it disappears; (*d*) the use of smaller amounts of the opaque chemical because the "bolus" can be followed on serial films and it is no longer necessary "to keep the blood vessels filled" for a long period.

The main disadvantage of high-speed automatic radiography is the factor of expense to the patient and to the institution. This we must all take into consideration. It is well to keep in mind that in adults, and in older, co-operative children, angiocardiography can be satisfactorily accomplished by conventional equipment and by scrupulously following the original technics. The more elaborate equipment makes it possible to do a better job on infants and unco-operative subjects, with assurance of a comprehensive visualization of all the chambers and great vessels with a minimum of risk.

CLINICAL APPLICATIONS

In the discussion of the clinical application of angiocardiography, a statement by Carman (39), taken from his book, is apropos, to quote, "It is . . . important that . . . we remember the rights of the patient. It is his just due that all features of his condition shall be properly weighed, not only separately, but also in their relations to each other and as a whole. Many roentgen manifestations are as yet intelligible only in the light of clinical and other facts."

Before angiocardiography is employed, all routine physical, laboratory, and conventional fluoroscopic and radiographic examinations should be undertaken, including electrocardiograms and oxygen consumption tests. Cardiac catheterization in our opinion should be carried out only after angiocardiography, because it is a long and difficult procedure and in most instances the diagnosis becomes apparent without it. If, under these circumstances, the diagnosis can be accurately established and the thoracic surgeon does not require contrast visualization of the structures upon which he is going to operate, then angiocardiography should not be done as a matter of curiosity. It is indicated only in selected cases, where the diagnosis is not firmly established, in order to (*a*) gain supplementary information to confirm a suspected clinical diagnosis, (*b*) to visualize the defect or defects as to position, size, and location as an aid in surgical intervention, and (*c*) to discover associated defects that might not have been suspected from the other examinations.

Specifically, angiocardiography has been profitable in the study of normal hearts (30, 33, 62, 86) by identifying accurately the position and extent of the various chambers in forming the cardiac silhouette. Measurements (87) of the normal aorta and pulmonary arteries in adults have been established for reference if doubt exists as to whether or not a particular vessel is enlarged or stenosed. In 1947, Chavez (88) and his co-workers published an excellent series of angiocardiograms on normal adults which are worth reviewing because of their exceptional contrast and detail. They were obtained by injection of the exposed external jugular vein in the neck.

Since this is bigger than a cubital vein, it could accommodate a larger catheter, which was passed into the right auricle. Fifty to 90 c.c. of diodrast were injected within three-quarters of a second. Rossi and Prader (89), also de Carvalho (90), recommend this vein and inject it directly without inserting a catheter. They point out that the negative venous pressure in the vena cava induces a more rapid flow of the opaque material into the auricle, with consequent greater contrast. We do not recommend this as an advisable approach. Others (91) have tried to improve the contrast of angiograms by using the Valsalva maneuver to provide a temporary reduction of cardiac output. This causes the blood flow to slow. The opaque chemical is then injected quickly. The patient exhales, which increases the blood velocity in the vessel, and the bolus of opaque material moves through it in greater concentration to provide a better angiogram. This is practical in adults, but not in children.

Angiocardiography has been helpful in the analysis of the various types of acquired cardiovascular disease—arteriosclerotic (92), hypertensive (92), rheumatic (93), syphilitic (94, 95), and pulmonary (96). These are fields that should prove fruitful with further exploration. This method has been effective in the clarification of obstructions to the superior vena cava (97, 98), in the understanding and demonstration of pulmonary arteriovenous aneurysms (99–101), and in the diagnosis of pericarditis with effusion (102). It has been helpful in the differentiation of aortic aneurysms and mediastinal tumors (103–105), but cannot always be relied upon, as the aneurysm may contain a blood clot which will prevent the contrast medium from filling it. The same word of caution applies to the diagnosis of dissecting aneurysms (106) of the thoracic aorta by angiocardiography. Blakemore (99) has found aortograms useful in checking the degree of clotting obtained with aneurysms following electrothermic coagulation.

Angiocardiography has been used by others (107–110) to assist in determining the operability of bronchogenic carcinoma, mediastinal tumors, and tuberculous infections, by visualizing the relationship of these lesions to the great vessels and the complications induced by them through invasion of the vessel or blockage by pressure. The procedure has been employed by Neuhof and Nabatoff (111) to study the form and function of the remaining lung after pneumonectomy. They reported no significant abnormality in size, shape, or distribution of the vascular pattern in the remaining lung. This technic has made it possible to view the lesser circulation in a new light and with it the variations in size and shape of the pulmonary segment (112, 113) together with some of the changes it undergoes due to idiopathic dilatations (114) and aneurysms (115–118), as well as distinguishing these conditions from tumor masses in the hili.

The greatest value of angiocardiography has been in the diagnosis of congenital malformations of the heart (22, 23, 119–122), and especially in the accurate detection and selection of those that are amenable to surgical correction. The most important cases of this group are those with pulmonary stenosis (123–125) and cyanosis, occurring either as an isolated defect or associated with other anomalies, as in the tetralogy of Fallot, in tricuspid stenosis or atresia with a non-functioning right ventricle, or rarely, in complete transposition of the great vessels (126). By the detection of these entities, unnecessary exploratory operations can be avoided. Angiocardiography has also been helpful in the diagnosis of intracardiac shunts (127), occurring either alone or in association with other malformations. However, the demonstration of a small or even a large auricular septal defect alone is often impossible.

Of almost equal importance is the use of angiocardiography in the recognition of those cardiac anomalies accompanied by cyanosis that cannot be helped by the surgical measures now available, namely

TABLE II: CONGENITAL HEART DISEASE

Hospital admissions (Jan. 1947 to Nov. 1950)	350
Angiocardiography and aortography	161
Surgical procedures done	82
Operated without angiographic examinations (9.7%)	34

This table indicates the frequency with which angiocardiography and aortography are performed on patients admitted to the hospital with the diagnosis of a congenital malformation of the heart. Only patients admitted to the hospital are included in this series. No outpatients are listed. Approximately a little less than one-half of the patients admitted are subjected to these procedures. Of those patients undergoing surgical treatment, a little less than one-half are operated on without any angiographic examination.

Eisenmenger's syndrome, truncus arteriosus, and cor biloculare, all of which can be shown by this means. Occasionally when the clinical diagnosis of a patent ductus arteriosus (128) is uncertain or is obscured by other defects, it can be established angiocardiographically. The demonstration of congenital anomalies of the aorta and its major branches, such as coarctation and "aortic rings" produced by reduplications of the aortic arch or aberrant subclavian arteries, is often highly advantageous to the thoracic surgeon prior to operation. In children and small adults, they can usually be shown by angiocardiography (129), but in large individuals are better visualized by retrograde aortography.

Many excellent books and articles have been written on the clinical diagnosis of these congenital malformations of the heart. The radiologist who is interested in this work should be familiar with at least the writings of Taussig (130), Brean and Neuhauser (131), Alexander and White (132), Dry (133), Parker and associates (134), Potts, Gibson, and co-workers (135, 136).

To obtain an idea of the frequency with which angiocardiography was requested by the professional staff, we reviewed the records of 350 subjects admitted to the hospital in the last four years with the diagnosis of a congenital malformation of the heart and found that a little less than one-half received angiocardiographic or aortographic examinations (Table II). One-half of these, or one-fourth of the total admitted, were subjected to surgical treatment. Of the operations, approximately one-half, representing 10 per cent of the admissions, were done without angiocardiography.

Of the 34 operations undertaken without angiographic examination (Table III), 16 were for tetralogy of Fallot, 11 for patent ductus arteriosus, 2 for coarctation of the aorta, and 1 each for pulmonary stenosis, reduplication of the aorta, Eisenmenger's complex, transposition of the great vessels, and interventricular septal defect. The last 4 of these cases, or about 10 per cent, could have been more accurately appraised had angiocardiography been done, and the operative procedure could have been avoided.

TABLE III: THIRTY-FOUR CASES IN WHICH OPERATION WAS DONE WITHOUT ANGIOGRAPHY

Tetralogy of Fallot	16
Patent ductus arteriosus	11
Coarctation of aorta	2
Pulmonary stenosis	1
Eisenmenger's complex	1
Transposition of great vessels	1
Reduplication of aorta	1
Interventricular septal defect	1

In 4, or about 10 per cent of the patients undergoing operative treatment for congenital malformations in the heart without angiographic examination, a more accurate diagnosis could have been made had they been subjected to angiocardiography and the operation avoided.

Obviously, space is not available for the illustration of all these conditions, but there are some that I wish to demonstrate, and certain points that I wish to emphasize with selected cases.

CASE 1, *Tetralogy of Fallot:* P. W. H., a 6-year-old white boy, had been cyanotic since birth. He had frequent "fainting spells" and was underdeveloped and physically retarded. While playing, he would often have to squat to rest. His lips and nails were cyanotic. A loud systolic murmur was heard at the apex and in the pulmonic area. A fluoroscopic examination revealed that the heart was within normal limits as to size but had only a questionable concavity in the region of the pulmonary conus. The pulmonary vascular markings were scant. While the clinical diagnosis was tetralogy of Fallot, it was not clear-cut in view of the minor concavity for the pulmonary conus. Angiocardiograms made following the injection of 25 c.c. of 75 per cent neo-iopax, with the patient in a slight left posterior oblique position, are reproduced in Figure 10. In A the

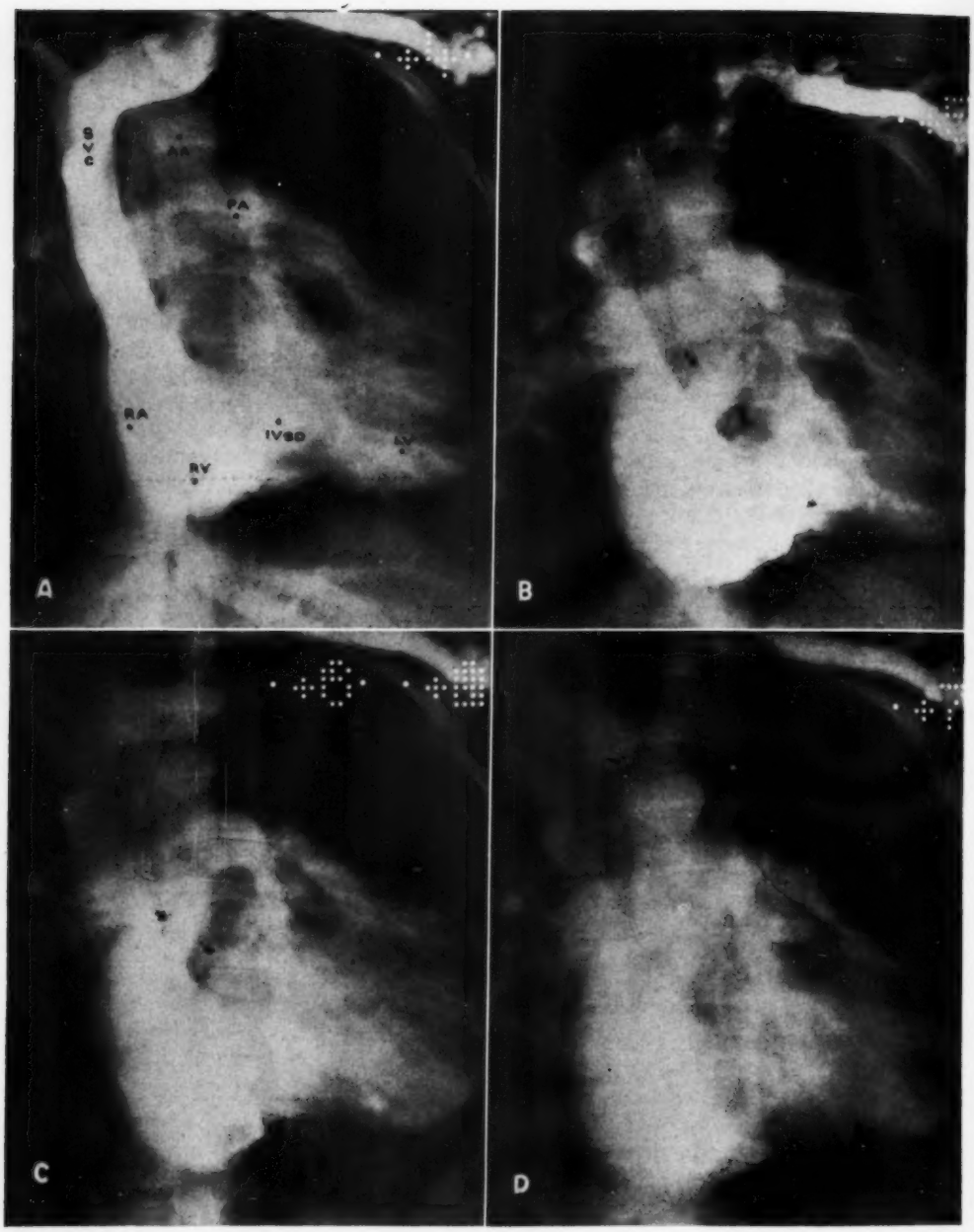

Fig. 10. Case 1: Tetralogy of Fallot. This series of four consecutive films made at intervals of one-half second illustrates the desirability, in fact the necessity, of having a continuous series of exposures for the accurate interpretation of angiocardiograms. In only B and C is the narrowed stenotic pulmonary conus visualized. The demonstration of this stenotic segment is the key to the radiographic diagnosis of a tetralogy of Fallot, as interventricular septal defects and the overriding of the aorta are more easily recognized, the former by seeing the opaque medium flow from the right ventricle into the left and the latter by its filling simultaneously with the pulmonary arteries. Furthermore, serialized films are valuable in confirming the constancy of a questionable defect, as well as in distinguishing between what might be a pathological narrowing and the changes in size that take place normally between systole and diastole.

SVC. Superior vena cava. RA. Right auricle. RV. Right ventricle. IVSD. Interventricular septal defect. LV. Left ventricle. AA. Ascending aorta. PA. Pulmonary artery. Arrows designate stenotic pulmonary infundibulum.

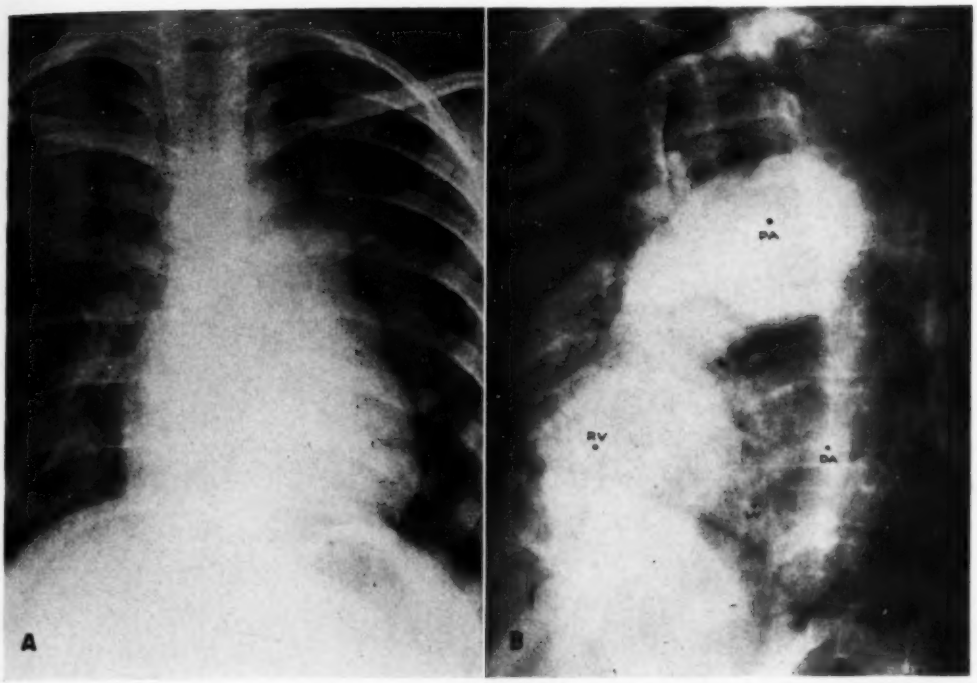

Fig. 11. Case 2: Eisenmenger's complex. The configuration of the heart in the conventional film, A, is compatible with the changes seen in Eisenmenger's complex, but similar configurations can be produced by a patent ductus arteriosus or an auricular septal defect. The angiogram, B, establishes the diagnosis of Eisenmenger's complex, for it demonstrates the enlarged infundibulum and pulmonary arteries. The left ventricle and aorta were simultaneously visualized with the pulmonary conus, which indicates an interventricular septal defect and an overriding of the aorta. This angiogram was the only one in the series that clearly showed the large pulmonary conus; in the remaining films, the opaque chemical in the cardiac chambers obscured this structure by superimposition.
RV. Right ventricle. PA. Pulmonary artery. DA. Descending thoracic aorta. LV. Left ventricle.

opaque medium has filled the superior vena cava, the right auricle, and ventricle and has spread through a huge interventricular septal defect into the left ventricle and filled the pulmonary conus and arteries and the aorta simultaneously. In B the pulmonary conus is clearly visualized, being approximately one-half as large as it should be, due to a stenosis. In C, half a second later, the pulmonary conus is again visualized and is even smaller, due to systole. In D the opaque medium has covered the conus due to the filling of overlying heart cavities.

This case demonstrates one of the great advantages of having a continuous series of films available for inspection, as only one or two of the entire series may prove to be the key to the accurate diagnosis.

CASE 2, *Eisenmenger's Complex:* M. F. S., a 10-year-old white school girl, was underdeveloped and small for her age. Since birth she had been dyspneic on exertion and for the last few years her family had noted a "bluish tinge" to her lips, fingers, and ears. Her fingers and toes were clubbed. On the conventional film (Fig. 11A), the heart is seen to be slightly enlarged and there is a definite bulge for the pulmonary conus. In the series of angiocardiograms, only No. 6 (Fig. 11B) clearly visualizes a large infundibulum and pulmonary conus and arteries. The opaque medium is also seen in the left ventricle and in the aorta. These structures were visualized simultaneously with the large pulmonary conus, indicating an interventricular septal defect and an overriding of the aorta.

The demonstration of the large pulmonary conus differentiates this case from tetralogy of Fallot and establishes it as an Eisenmenger's complex.

CASE 3, *Tricuspid Atresia with Non-Functioning Right Ventricle Associated with Pulmonary Stenosis:* P. A., a 13-year-old white girl, was underdeveloped and thin. A definite cyanosis of the lips and fingernails had been noticed since she was ten months of age. On exertion, she would become short of

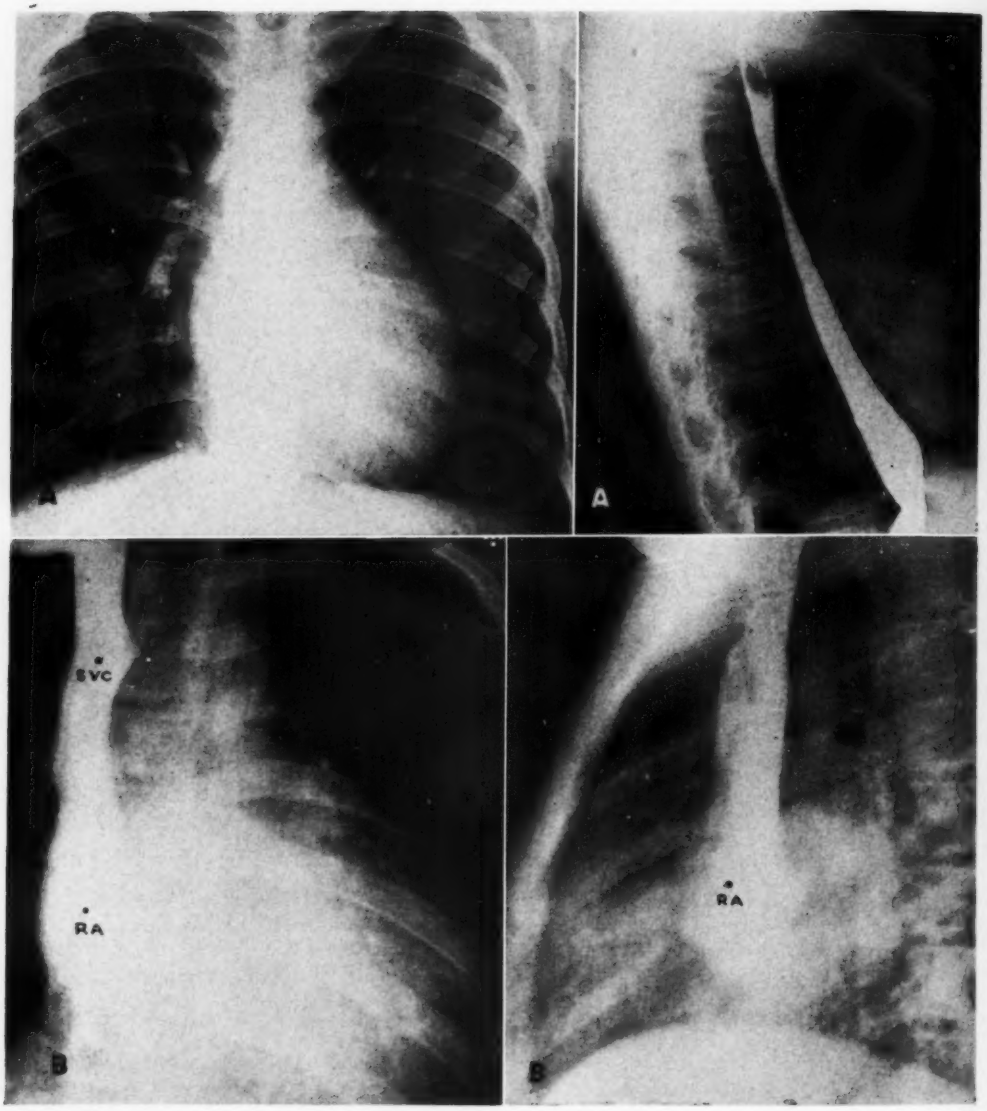

Fig. 12A and B. Case 3: Tricuspid stenosis or atresia with absent or non-functioning right ventricle with associated pulmonary stenosis. This disorder must be accurately diagnosed, for when it is associated with a pulmonary stenosis, it becomes amenable to surgical correction by an aortic-pulmonary artery anastomosis.

A. Conventional film, revealing a globular heart with fullness over the upper half of the left border. The pulmonary vessels are small and less numerous than usual.

B. The angiocardiograms were taken following a single injection of 30 c.c. of 70 per cent neo-iopax into an antecubital vein. The anteroposterior and lateral views were made alternately at quarter-second intervals. The opaque medium is in the superior vena cava and the right auricle. See also Fig. 12C and D.

SVC. Superior vena cava. RA. Right auricle.

breath and would frequently have to squat and rest to get her breath. Her fingers and toes were clubbed. A loud systolic murmur and thrill could be heard over the precordium. In the conventional film of the chest, A in Figure 12, the heart appears slightly enlarged and presents a globular outline largely due to an outward projection of the left border, but without any enlargement posteriorly. Angiocardiograms were made on the twin rapidograph after the injection of 30 c.c. of 70 per cent neo-iopax into an ante-

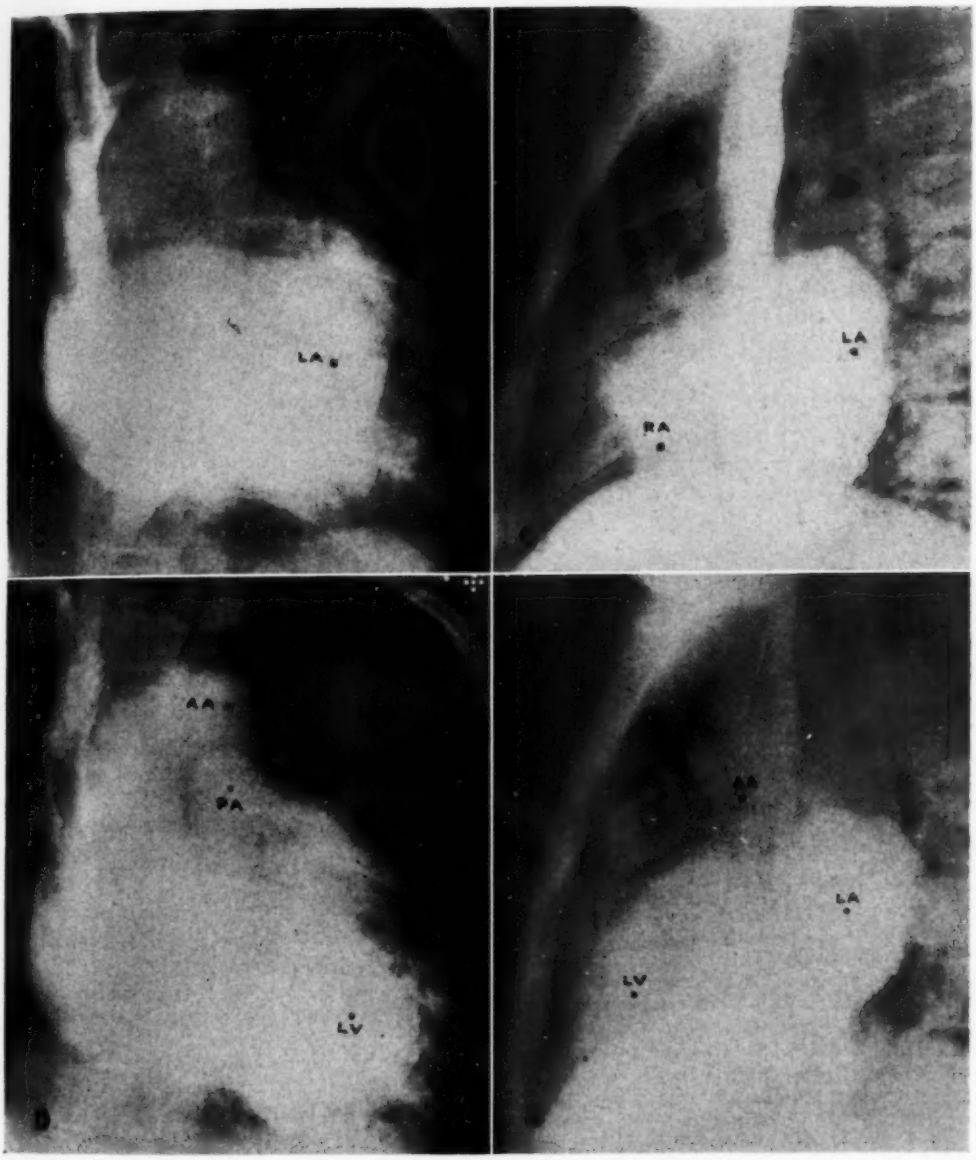

Fig. 12C and D. Case 3 (see also Fig. 12A and B).

C. Half a second after the angiogram shown in B the opaque material has passed through an interauricular septal defect into the left auricle. The atresia of the tricuspid valve prevents any filling of the right ventricle.

D. One second later the contrast medium has filled the left ventricle and has been ejected into the aorta, pulmonary conus, and pulmonary arteries. Note how little of the opaque material fills the pulmonary arteries due to a pulmonary stenosis.

The self-cocking Potter-Bucky grid has been effective in cleaning up the scattered radiation, with very little fogging of the film in either of the two magazines.

AA. Ascending aorta. RA. Right auricle. LV. Left ventricle. LA. Left auricle. DA. Descending thoracic aorta. LV. Left ventricle.

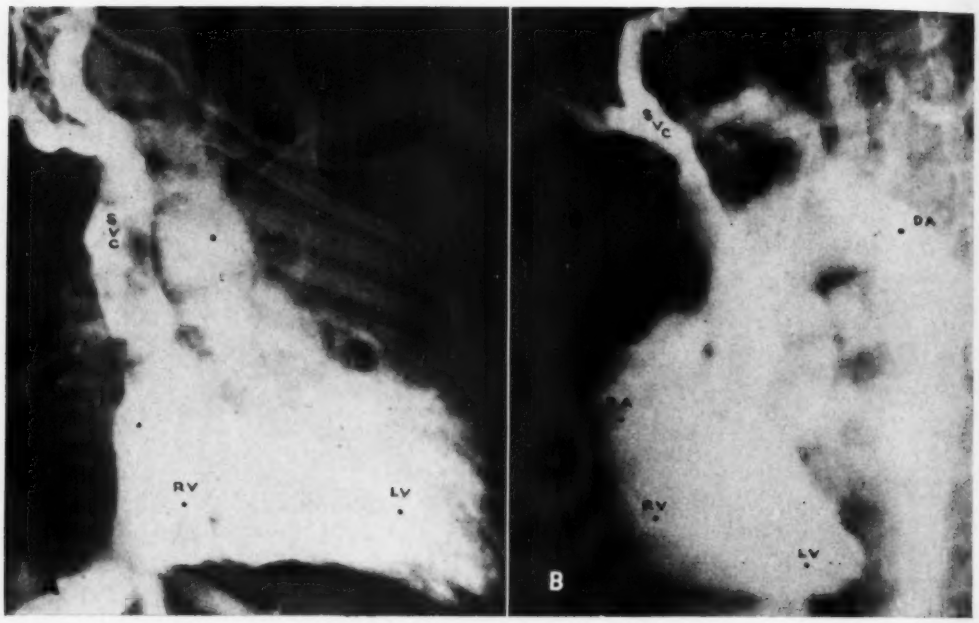

Fig. 13. Case 4: Tetralogy of Fallot. The right and left posterior angiocardiograms were made on a 10-months-old infant after a single injection of 15 c.c. of diodrast into a vein in the elbow. They were taken on the double rapidograph at quarter-second intervals.

In A and B the contrast medium fills the superior vena cava, the right auricle, and the right ventricle, and has been ejected simultaneously into a small stenotic pulmonary conus and the aorta. In neither of these films nor in the remaining exposures in the series were any large pulmonary arteries demonstrated. At operation the surgeon had difficulty in locating a pulmonary artery of sufficient size for a satisfactory anastomosis with the aorta. This was attempted, but it was inadequate, and the infant expired some hours later.

Angiocardiography should be used not only to assist in establishing a correct diagnosis, but also as a means of supplying pertinent anatomical information prior to operative procedures.

SVC. Superior vena cava. RA. Right auricle. RV. Right ventricle. LV. Left ventricle. AA. Ascending aorta. DA. Descending thoracic aorta.

cubital vein. The anteroposterior and lateral views were obtained alternately in succession at quarter-second intervals. In B the opaque medium is in the superior vena cava and in the right auricle. In C it has spread through a large interauricular septal defect to fill the left auricle. None of the opaque material is in the region of the right ventricle, due to a stenosis or atresia of the tricuspid valve resulting in an absent or non-functioning right ventricle. In D the contrast medium has passed into the left ventricle and out into the aorta and pulmonary arteries. The pulmonary arteries are small and contain only little contrast medium, which is strong indirect evidence of a pulmonary stenosis. The pulmonary conus and infundibulum are not visualized even in this complete series of angiograms, due to the overlying opacity of the chambers of the heart that surround these structures.

This child was subjected to an aortic-pulmonary artery anastomosis of the Potts-Smith type, with immediate improvement, and has since been able to indulge in moderate physical activities without distress.

CASE 4, *Tetralogy of Fallot:* M. R. W., a 10-months-old white boy, had been cyanotic since birth. He was poorly developed and was dyspneic even when given supplementary oxygen. He had had frequent upper respiratory infections and on one occasion a bronchopneumonia. Angiocardiograms were made after the injection of 15 c.c. of diodrast into a vein in the elbow. The right posterior-oblique and the left posterior-oblique views (Fig. 13) were made at alternate intervals of a quarter of a second on the double rapidograph. In A the opaque material is in the right auricle and ventricle and has been ejected simultaneously into a small stenotic pulmonary conus and into the aorta. In B a very small amount of the opaque medium is spilling through a small high interventricular septal defect into the left ventricle. It is important to note that both of these films and the remaining ones of this series showed only small pulmonary vessels and no single large pulmonary artery. At operation it was

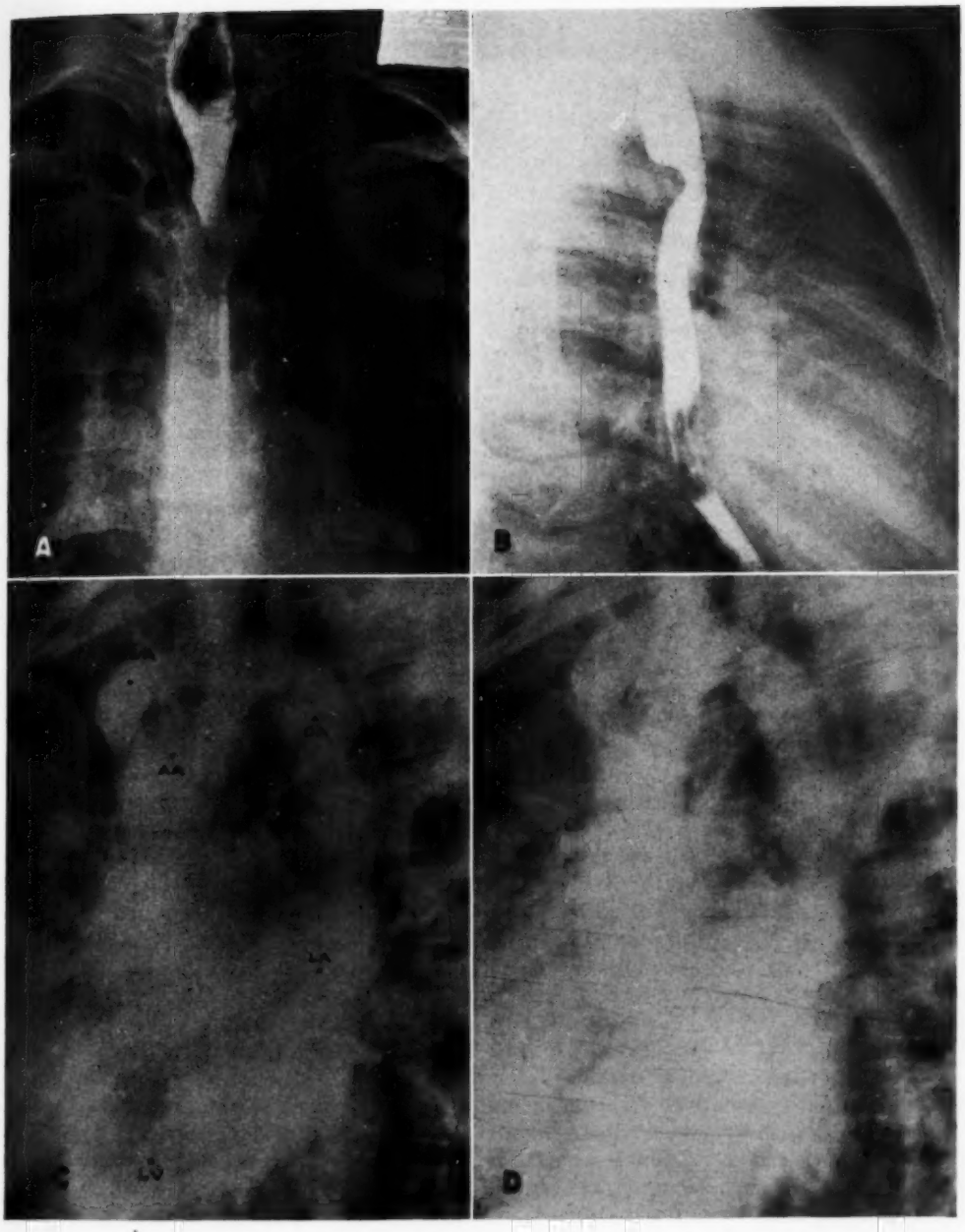

Fig. 14. Case 5: "Aortic ring" with an anomalous left subclavian artery. An 8-year-old child had been in the hospital because of repeated attacks of bronchopneumonia. The conventional films, A and B, revealed a right-sided aortic arch and anomalous left subclavian artery.

The angiocardiograms, C and D, showed, in addition, an "aortic ring" caused by a communicating vessel which represented the left aortic arch. Encircled between it and the right aortic arch were the trachea and esophagus. At operation it was necessary not only to ligate the left subclavian artery but also to excise the persistent communicating left aortic arch in order to free the trachea and esophagus.

Angiocardiography in this instance prepared the surgeon in advance for a complicating factor that was not apparent from the examination by conventional methods.

LV. left ventricle. LA. Left auricle. AA. Ascending aorta. RLA. Reduplication of left aortic arch. DA. Descending thoracic aorta.

difficult to find a pulmonary artery of sufficient size for a satisfactory anastomosis to the aorta. One was tried, but it was inadequate and the patient expired some eighteen hours after the operation.

Angiocardiography is not only helpful in establishing the accurate diagnosis but many times can supply pertinent anatomical information to the thoracic surgeon.

CASE 5, *"Aortic Ring" with an Anomalous Left Subclavian Artery:* M. E. R., an 8-year-old white girl, gave a history of repeated admissions to the hospital because of recurring attacks of bronchopneumonia. She had never been cyanotic and there was no clubbing of the fingers. She was thought to have had a congenital malformation of the heart since infancy and had been on restricted physical activity. A loud systolic murmur was heard over the base of the heart. Conventional films of the heart during a barium swallow (Fig. 14A and B) showed the aortic arch on the right side. A deep indentation was present over the posterior aspect of the esophagus characteristic of the defect produced by an anomalous left subclavian artery. Angiocardiograms demonstrated a reduplication of the aortic arch as a partial cause of this defect (Fig. 14C and D). Usually the aorta and great vessels can be satisfactorily demonstrated only by intravenous angiocardiography with strict adherence to every detail of the technic and only in children or small adults. In most cases the aorta and its branches are better visualized by retrograde aortography.

At operation the main aortic arch was found on the right side. A small communicating vessel, representing a persistent left aortic arch, ran between the ascending and descending portions of the aorta. Encircled between the two aortic arches were the trachea and esophagus. This communicating artery was excised at its point of origin and termination, but the esophagus was not completely freed, as the anomalous left subclavian artery exerted pressure on it. This artery was then ligated to free completely the trachea and esophagus.

A contribution of angiocardiography that should not be overlooked is the better understanding of congenital malformations of the heart that it has given the medical profession. It has been an educational factor for radiologists and pediatricians in the more effective interpretation of the conventional fluoroscopic and radiographic examinations in patients with congenital cardiac defects It has brought a better understanding of these disorders and, because of the increased knowledge, the routine radiographic examination has become more effective in their detection.

RETROGRADE AORTOGRAPHY

A second method for the visualization of the aorta and its main branches is aortography either by direct puncture of the vessel with a needle that has passed through the intact chest wall, or indirectly by inserting a needle into one of larger branches and forcing the opaque material counter to the blood flow back into the aorta. By these methods a much higher concentration of the opaque chemical is achieved in the aorta than by intravenous angiocardiography, which necessarily results in a dilution of the medium with blood as it passes through the pulmonary circuit. This higher concentration of the chemical renders the aorta more dense and produces a film of greater contrast and clarity for the diagnosis of abnormalities in the aorta and its branches. Retrograde aortography eliminates the obscuring shadows of the overlying chambers of the heart and pulmonary vessels that are filled with opaque medium in angiocardiography and make it difficult to detect a communication between the aorta and pulmonary artery. The procedure has been helpful in the better visualization of the site, extent, and length of coarctations of the aorta, in the positive demonstration of patent ductus arteriosus, in anomalies involving the arch of the aorta and its major branches, in the differentiation of aneurysms and mediastinal tumors, and in visualizing the coronary arteries. It has also been used to demonstrate the results of operative procedures for aortic-pulmonary anastomoses and the effectiveness of aortic anastomoses after resection for coarctation. Gross (137) points out that infants and small children with coarctation of the aorta should not be operated upon, because of a lack of adequately developed collateral channels of circulation and also because of the possibility that the postoperative anastomotic site may not keep pace with the growth of the rest of the aorta. Aortography thus is of value in establishing the adequacy of the collateral circulation in patients being considered for surgical correction of coarctation.

The principal disadvantage of retrograde aortography is that it requires the surgical exposure of the artery to be injected. This usually necessitates the use of the operating room, and the resulting scar after closure is something to be avoided, particularly in girls. This is especially true if the common carotid artery is selected and is one reason why the brachial or axillary arteries may be better approaches, although we have continued to use the common carotid.

For clinical purposes, the direct method has not been used for several years because of the hazard of incurring complications. Various technics have been reported by Radner (138) in 1945, Blakemore (99) in 1946, and Meneses Hoyos and Gomez del Campo (139) in 1948. Practically all patients are now examined by the retrograde or counter-current method which was originated by Castellanos, Pereiras, and Cazañas (140), who in 1942 injected the opaque medium into the left brachial artery against the direction of the blood flow and forced it back into the thoracic aorta. In their publication they demonstrate a normal aorta and a coarctation in a child six months old. They originated the name "retrograde or counter-current aortography" and deserve full credit for this development (141, 142).

Radner (143) in 1948 conceived the idea of feeding a catheter through the radial artery under fluoroscopic control into the ascending aorta and then injecting 70 per cent diodrast and making aortograms. Brodén, Hanson, and Karnell (144) used Radner's method to demonstrate coarctations in two patients, but they were frank in stating that the procedure is time-consuming and that it is frequently difficult to introduce the catheter because of arterial spasm. Jönsson (145), with this same group and using the same technic, demonstrated a communication between the aorta and the pulmonary artery to establish the liagnosis of patent ductus arteriosus. These workers also advocate the method as a means of showing the coronary arteries. Recently, in 1950, Helmsworth and associates (146) reported their experiences in adapting a polyethylene catheter to Radner's technic for thoracic aortograms. The chief recommendation for the use of a catheter is that its tip can be placed at the location in the vessel where the maximum concentration of a contrast medium is desired.

Burford and Carson (147) in 1948, and later with Scott (148), and then Freeman and Miller (149), independently of each other, selected the left common carotid artery as the most convenient route for retrograde aortography and obtained excellent aortograms in children and adults. In our technic the patient is prepared with a general ether anesthesia. The left common carotid artery is exposed by surgical dissection. The patient is then brought to the x-ray department and placed in the right posterior-oblique position on the radiographic table. Three silk ligatures are passed around the artery but are not tied. In rapid sequence, the lowermost ligature is tied to occlude the artery; the upper ligature is tied to prevent cephalad reflux of the dye; a small incision is made transversely in the vessel wall, and a No. 10 cannula is introduced with the tip directed toward the heart. The second ligature is tied around the vessel just below the opening in the wall and over the shaft of the cannula to prevent blood leakage. The lowermost ligature is freed and the rapidograph is started. After the first exposure, 20 to 40 c.c. of a 70 per cent concentrated contrast medium are injected very rapidly while the x-ray exposures are continued for four or five seconds. The lowermost suture is now tightened and the middle one loosened. The cannula is withdrawn and the small opening in the vessel wall sutured with 00000 silk on a nontraumatic needle. The short incision in the neck is repaired in the usual manner.

Jönsson (85) by 1949 had devised a method for the percutaneous insertion of a double cannula into the common carotid artery. After the cannula had pierced the artery, the inner cannula was withdrawn and a silver thread inserted. The outer

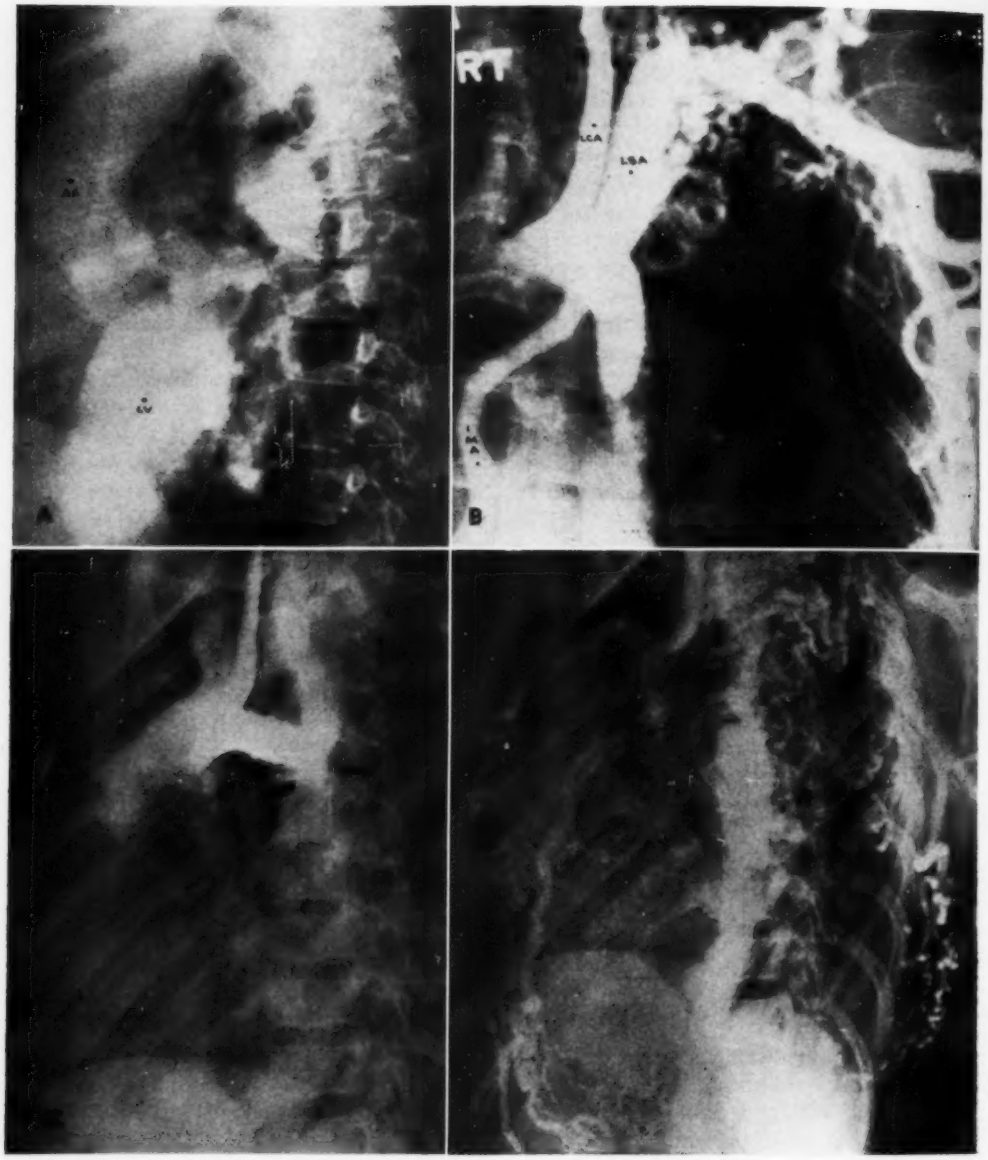

Fig. 15A–D. Various examples of coarctation of the aorta. A. Case 6. Intravenous angiocardiogram of excellent quality in a 14-year-old boy, demonstrating a coarctation with moderate narrowing and the characteristic post-stenotic dilatation of the aorta. Intravenous angiocardiograms are seldom satisfactory for the diagnosis of this defect. The left auricle is in systole and the left ventricle in diastole. Note the tortuosity of the aorta near the coarctation and the lack of collateral circulation, as narrowing of the aorta was only slight in this instance.

B. Case 7. Retrograde aortogram of a 16-year-old student made in the right posterior oblique position, illustrating a practically complete obstruction at the coarctation, with the development of an extensive collateral circulation. The coarcted segment is short, which made the resection and anastomosis less difficult to accomplish. In this case, the aortograms were helpful in assisting the surgeon in planning the operation ahead of time.

C and D. Case 8. The retrograde aortograms on this 15-year-old boy reveal extreme narrowing of the aorta at the site of coarctation. D, taken one second after C, is a remarkable illustration of the tremendous collateral circulation that develops around the site of a marked obstruction that has existed over a period of years. After viewing this film, it is far easier to appreciate why these patients with coarctations have a much shorter life expectancy and why complications develop from arterial diseases. In this case, the coarcted segment was successfully removed and the aorta anastomosed, with complete relief of symptoms.

AA. Ascending aorta. LV. Left ventricle in diastole. LCA. Left common carotid artery. LSA. Left subclavian artery. IMA. Internal mammary artery, right.

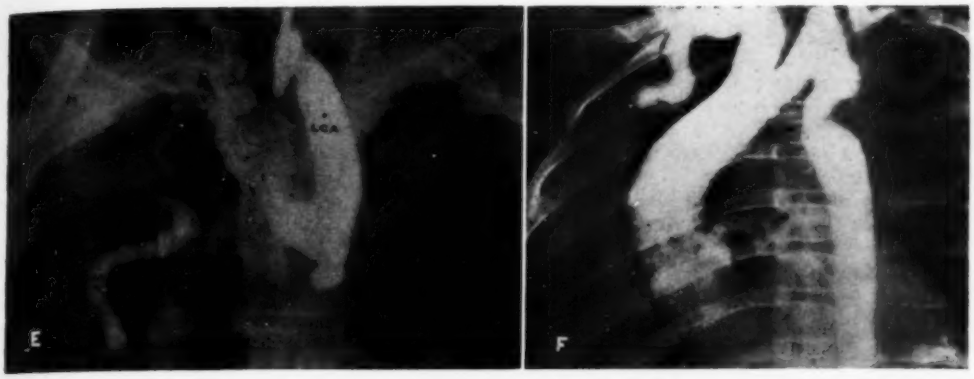

Fig. 15E and F. E. Case 9. A retrograde aortogram was obtained on this 11-year-old girl not only to determine the characteristics of the coarctation in the aorta, but also to demonstrate why the blood pressure in the left arm was 45 points lower than in the right. The aortogram shows a complete occlusion of the aorta with non-filling of the left subclavian artery. At operation, a coarcted segment was resected and with it an extension of the occluding membrane across the point of origin of the left subclavian artery. Removal of this membrane and subsequent anastomosis permitted an adequate flow of blood into the left subclavian artery and the descending thoracic aorta.

F. Case 10. This retrograde aortogram was made on an 8-year-old girl with rheumatic heart disease and a coarctation. The heart is enlarged. The coarcted segment has reduced the lumen of the aorta to about one-third the normal diameter for a distance of about 1.5 cm. This child also had a lower blood pressure in the left arm than in the right, which is explained by the incomplete filling and small size of the left subclavian artery. The enlarged right internal mammary artery is just beginning to fill, indicating that adequate collateral circulation has developed. Note how clearly the left coronary artery and its two main divisions are pictured by this method.

IMA. Internal mammary artery, right. LCA. Left common carotid artery.

cannula was then guided down into the ascending limb of the aorta. It was connected to a pressure injection apparatus which could force the contrast medium through the narrow needle within a few seconds. This is a rather complicated method and we have found no reason for utilizing it.

The following case reports illustrate some of the points we have mentioned, with particular reference to aortography and the diagnosis of coarctations and persistent patency of the ductus arteriosus.

CASE 6: G. B., a 14-year-old boy, was a little smaller than children of his age; he tired easily and had no "pep." A systolic thrill and murmur were present over the base of the heart. The blood pressure in the upper extremities was 130/90 and in the lower extremities 114/70. The chest film did not reveal any definite areas of erosion on the under surface of the ribs. Intravenous angiocardiograms were made with the patient in the right posterior-oblique position and demonstrated a coarctation of the aorta with only moderate narrowing (Fig. 15A).

Nearly technically perfect angiocardiograms are necessary to demonstrate this disorder in the aorta. However, as the radiographic technic becomes better, the contrast will be improved on the films and intravenous angiocardiography may become a satisfactory procedure for this work.

CASE 7: C. S., 16-year-old white male student, had no complaints other than a tendency to tire easily and headaches after exercise. During a routine physical examination four years previously his pediatrician had discovered a coarctation. On admission to the hospital the blood pressure in the upper extremities was 160/110; it could not be obtained in the lower extremities. Retrograde aortograms were made after the injection of 50 c.c. of 75 per cent neo-iopax into the right common carotid artery. A practically complete obstruction was present at the site of the coarctation (Fig. 15B). The narrowed segment was short and the thoracic surgeon could see that no complicating factor was present to hamper the anastomosis, which was successfully accomplished.

CASE 8: W. W., a 15-year-old boy, had a history of "high blood pressure" for two years. Exercise was followed by headaches and blurring of vision. He became dyspneic, but was never cyanotic, even after heavy exertion. The blood pressure in the right arm was 165/105 and in the left arm 160/100. A loud diastolic murmur was heard over the base of the heart. On the conventional film of the chest the heart was seen to be slightly enlarged to the left and the "notching" on the under surfaces of the ribs, characteristic of a coarctation, was readily observed. Retrograde aortograms were made to determine the extent of narrowing produced by the coarctation and

the length of the coarcted segment. The almost complete atresia of the aorta is seen in Figure 15C, while 15D, taken a second later, is an excellent illustration of the tremendous collateral circulation that occurs when there is a marked narrowing of relatively long standing.

CASE 9: G. F., an 11-year-old white girl, entered the hospital without any complaints referable to the heart. She had not experienced any decrease in exercise tolerance and at no time had she noticed any cyanosis. She had been seen in the out-patient department, where a precordial systolic thrill and a loud aortic systolic murmur were detected. In addition, the blood pressure was found to be 150/90 in the right arm and 105/80 in the left arm. In the legs it was not obtainable, and the diagnosis of a coarctation was considered. In the conventional film of the chest, the heart was found to be in the upper limits of normal as to size and the aortic knob was inconspicuous. The inferior borders of the sixth to the ninth ribs on the right were slightly scalloped. Retrograde aortography was done for the purpose of visualizing the extent of the coarctation and in hope of learning the cause of the difference in blood pressure in the two arms. A coarctation with a complete occlusion of the aorta was found. The left subclavian artery was not filled with the opaque chemical and we therefore concluded that it was shut off at its point of origin by the coarctation or a similar disorder. The surgeon found this to be the case and was successful in resecting the occluded segments and re-establishing continuity by direct anastomosis.

CASE 10: N. T. P., an 8-year-old girl, was known to have had rheumatic heart disease for at least two years, during which time she had been chronically ill, with exacerbations and remissions. She was thin and underdeveloped. A variety of murmurs could be heard over her chest. It had been noted that the blood pressure in her right arm was 170/80 and in the left arm 100/75. The blood pressure in her lower extremities could not be obtained. Very minor scalloping could be seen on the under surfaces of a few of the ribs. In an effort to alleviate the combined handicap of rheumatic heart disease and a coarctation of the aorta, it was decided to visualize the coarctation to determine what complications might be present and the requirements demanded for surgical correction. On the aortogram (Fig. 15F), the coarcted segment is well demonstrated; it is approximately one-third the size of a normal aorta and about 1.5 cm. in length. The left subclavian artery is small, which explains the lower pressure in the left arm. The large internal mammary artery on the right just beginning to fill, shows that adequate collateral arterial circulation is present. The left coronary artery and its two main divisions are exceptionally well shown and indicate how this method of aortography can be used for their visualization.

Before going on to a discussion of patent ductus arteriosus, it should be pointed out that some patients with the symptoms of coarctation do not have this disorder, but may have a constriction of the aorta at the level of the diaphragm, as reported by Olim (150). We have had a similar case, presumably due to a traumatic narrowing of the aorta at a level just below the diaphragm.

CASE 11: W. F., a 7-year-old girl, was seen with evidence of a persistent patent ductus arteriosus. She was short and underdeveloped for her age and experienced moderate dyspnea and palpitation on exertion. A continuous "machinery murmur" could be heard over the base of the heart, coinciding with a palpable thrill. On fluoroscopic examination the heart was seen to be moderately enlarged, the pulmonary conus was very prominent, and there was excessive movement of the hili, which has been referred to as the "hilar dance." The child was not cyanotic and did not have clubbing of the fingers. Some weeks later several enlarged cervical lymph nodes appeared in her neck and a biopsy was reported as showing metastatic carcinoma. This condition was not apparent initially. In the meantime, retrograde aortography revealed a definite communication between the aorta and the pulmonary artery (Fig. 16A). In fact, the patent ductus itself was nicely demonstrated.

CASE 12: H. C. M., a 4-year-old boy, was poorly nourished and developed. Considerable variations in the blood pressure recordings were noted, but no definite significance could be attached to this finding. There was mild difficulty in swallowing and food was frequently regurgitated. A continuous murmur was heard at the base of the heart, which was suggestive of the "machinery" type. In addition, a systolic murmur could be identified near the apex of the heart. The clinical impression was that the child had an anomaly of the aortic arch with a mild constriction of the esophagus, possibly associated with a defect in the aortic valve. The retrograde aortogram definitely established a large patent ductus arteriosus of the "window" or "slit" type communicating between the aorta and pulmonary artery (Fig. 16B).

This last case illustrates the fact that, while in most instances a patent ductus arteriosus can be readily identified by the clinical examination, it is sometimes difficult to recognize it when it is associated with other defects. In addition to the authors referred to in the discussion of aortography, Burchell (151) and Brodén and associates (152) have published excellent discussions on the diagnosis of persistent patency of the ductus arteriosus.

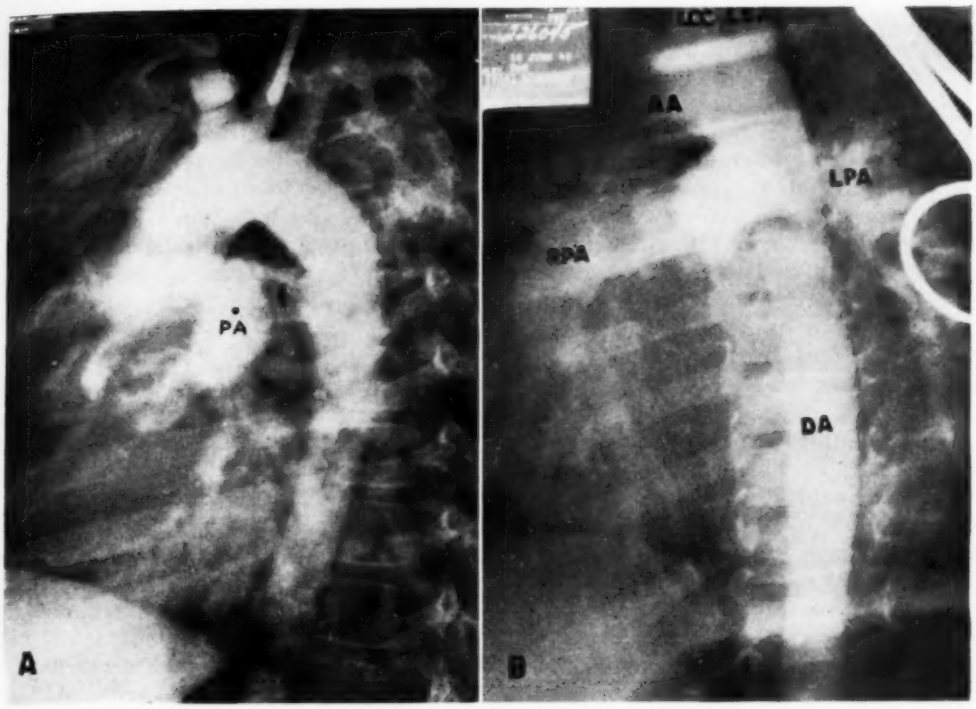

Fig. 16. Types of persistent patent ductus arteriosus of the adult type.

A. Case 11. Long patent ductus communicating between the aorta and the pulmonary artery in a 7-year-old girl, successfully visualized on the retrograde aortogram. Usually the ductus is not as long as this or one is not fortunate enough to view the patient at the exact angle which will throw it into relief.

B. Case 12. The retrograde aortogram on this 4-year-old boy reveals the common type of "slit" or "window" patent ductus arteriosus, in which the contrast medium flows directly from the aorta into the pulmonary artery. Because of complicated murmurs and other apparently associated defects, the diagnosis of a patent ductus arteriosus was not established by clinical examinations.

AA. Ascending aorta. LCC. Left common carotid artery. LSA. Left subclavian artery. RPA and LPA. Right and left pulmonary arteries. DA. Descending thoracic aorta. PA. Pulmonary artery.

While this lecture has been an attempt to cover the fields of angiocardiography and aortography, the literature is already too extensive to include every reference. A strenuous effort has been made to present a reasonably accurate development of the methods, procedures, equipment, and technics to detect the trends in these fields so that we may see what has been accomplished, what is now being done, and what the future direction may be. To this end the author has taken the liberty that is accorded the Carman Lecturers in formulating their conclusions.

CONCLUSIONS

1. Angiocardiography is becoming more widely employed in this country, but still remains a procedure for use in selected cases. It is especially valuable in the diagnosis of congenital malformations of the heart. It is applicable to about half of those individuals with these disorders that are admitted to the hospital for further diagnosis and appraisal and to a little less than half of those who undergo corrective surgical measures. The conventional methods of examination are usually satisfactory in about 50 per cent of the cases and should always be done first. Angiocardiography thus is a supplementary procedure.

2. The satisfactory application of angiocardiography and aortography to the diagnosis of congenital heart lesions has brought about a better understanding of these disorders and at the same time a wider

dissemination of knowledge about them. This has been a great help in the more effective use and interpretation of conventional fluoroscopic and radiographic examinations on this group of patients.

3. In regard to equipment the trend is toward integrated rapid serialized units with exposure rates of about two to six per second, using larger film, making roentgenograms approximating 12 × 12 inches. These factors are within the range of achievement of present equipment.

4. The ultimate perfection of radiographic equipment for the rapid or slow serialization of x-ray exposures on roll film will not limit it to angiographic procedures alone, but it will be adaptable to other diagnostic fields in which routine examinations can be expedited by the elimination of individual cassettes, such as in surveys of all types, gastro-intestinal studies, pneumoventriculography, etc.

5. High-speed serialized radiography in two planes provides an opportunity for recording the dynamics of the cardiac chambers. Such records may bring a better understanding of the mechanism and prognosis of various types of acquired heart disease. This technic can also be extended with promising rewards to other fields of angiography as we come to know more about the geriatrics of arterial disease.

6. Over the years, radiographic interpretation has been concentrated on the exterior of the heart—the cardiac silhouette. It is now turning to the appearance of the interior of the heart cavities, the communications between them, the origin of the great vessels within them, and to the valves.

7. At the present stage of development of angiocardiography it appears that in the not too distant future we will be viewing the "endothelial pattern" of the heart possibly in a manner similar to that we now employ in studying the mucosal pattern of the stomach, and will observe the characteristics of the mysterious coronary arteries much as we now do those of the brain.

8. In this country we have lagged a bit, probably justifiably, in the acceptance and application of angiography in general, but the evidence indicates that we are catching up. I venture to say that when the diplomates of last week's American Board of Radiology become of age, radiologically speaking, they will be appraising developments as marvelous to us of this generation as angiocardiography would have been to Russell Carman were he here tonight. I should like to conclude this lecture with a few lines from the book by Carman and Miller (39).

"...the individual examiner will find it advantageous to choose and follow as faithfully as possible the method which to him seems best. His routine should, of course, be flexible enough to vary in exceptional circumstances. Indeed, some degree of inventiveness and ingenuity is requisite in dealing with extraordinary circumstances....

"...it should also be emphasized that rigid adherence to any routine will not alone make diagnoses; that interpretation of findings, which can be learned only by experience, is quite as important as technical methods; and that the beginner must expect at least a few disappointments at first....

"...the essentials for satisfactory roentgen diagnosis are faithfulness to an orderly routine, careful observation, re-examination in doubtful cases, cautious and correlated interpretation, and last, but not least, a willingness to admit, whenever it is true, that the findings are inconclusive."

510 S. Kingshighway Blvd.
St. Louis 10, Mo.

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SUMARIO

El Desenvolvimiento de la Angiocardiografía y la Aortografía. Conferencia Carman

Trázase aquí el desenvolvimiento de la angiocardiografía desde los primeros experimentos de Sicard y Forestier en perros (1932) hasta nuestros días. Aunque el empleo de la misma se va divulgando en los Estados Unidos, continúa siendo todavía un procedimiento destinado a uso en casos seleccionados, cuyo mayor valor radica en el diagnóstico de las malformaciones congénitas del corazón, y sobre todo en el exacto descubrimiento y selección de las susceptibles de rectificación quirúrgica y en el reconocimiento de las irremediables en esa forma. Tiene aplicación aproximadamente en la mitad de los sujetos con malformaciones cardíacas que ingresan en el hospital para más completo diagnóstico y justipreciación y en algo menos de la mitad de los sometidos a medidas quirúrgicas correctivas. Los habituales métodos de examen suelen resultar satisfactorios aproximadamente en 50 por ciento de los casos y serán siempre ensayados primero.

La angiocardiografía ha sido además útil en el estudio de los corazones normales por identificar con exactitud la posición de las varias cámaras y de sus dimensiones al formar la silueta cardíaca y al establecer las mediciones de la aorta y las arterias pulmonares normales. También promete dar resultado en el análisis de las varias formas de afecciones cardiovasculares adquiridas: arterioescleróticas, hipertensas, reumáticas, sifilíticas, y pulmonares.

La elección de soluciones opacas para la angiocardiografía se limita a 70 por ciento de diodrasto, 75 por ciento de neo-yopax, y 70 por ciento de urocón. Como ninguna de ellas se halla exenta de riesgo, hay que escoger los enfermos con todo cuidado y que evitar las inyecciones repetidas, sin apiñarlas mucho.

Con respecto a instalación, la preferencia es hacia aparatos integrados, rápidos de serialización, con exposición a razón de dos a seis por segundo, utilizando película grande que dé radiografías de 30 × 30 cm. Esos factores quedan al alcance del instrumental actual. Las unidades dobles o gemelas para radiografía simultánea, seriada, a alta velocidad, en ángulo recto resultan ventajosas por permitir un examen extenso con una sola inyección de contraste y facilitar ocasión de registrar la dinámica de las cámaras cardíacas, aportando así una comprensión mejor de varias formas de cardiopatía adquirida.

Tenemos otro método para la visualización de la aorta y de sus principales ramas en la aortografía. Este procedimiento tiene aplicación mayormente en la determinación del asiento, la extensión y el largo de las coartaciones de la aorta, en el descubrimiento positivo del conducto arterioso permeable, en las anomalías que afectan el cayado de la aorta y las ramas principales del mismo, en la diferenciación de los aneurismas y los tumores del mediastino y en la visualización de las coronarias. También ha sido empleado para descubrir el resultado de las intervenciones cruentas en las anastomosis aórtico-pulmonares y la efectividad de las anastomosis aórticas consecutivas a la resección por coartación.

Primary Tumors of the Ureter: Their Roentgen Diagnostic Features[1]

R. BRIAN HOLMES, M.D.

Toronto, Canada

PRIMARY NEOPLASM of the ureter is often not suspected in the urologic patient until it is encountered at operation for removal of possible calculi or of a hydronephrotic kidney. Occasionally the diagnosis is made only after the specimen is in the hands of the pathologist. Inasmuch as most of these patients are studied by urography before any operative procedure is carried out, increased awareness on the part of the radiologist of the diagnostic possibilities and of the roentgen appearance of primary ureteral neoplasms should lead to more accurate diagnosis and more suitable handling of the patient by all concerned.

The great majority of discussions on ureteral tumors appear in the urologic literature; those stressing the radiologic features are rare. In 1945 Lazarus and Marks (2) reviewed the literature on primary carcinoma of the ureter and presented an unusual case. More recently (1948) Edelstein and Marcus (1) have discussed benign ureteral neoplasms.

Tumors of the epithelial lining of the urinary passages are frequently multiple, the ureter being involved along with or subsequent to the renal pelvis or bladder. The most common of these neoplasms is carcinoma. According to Scott (3), to be regarded as a primary carcinoma of the ureter, the tumor must have the gross and microscopic appearance characteristic of carcinoma; it must originate in the ureter and not be a transplant or a metastatic extension from a tumor elsewhere in the urinary tract. The material presented here has been gathered on essentially that basis; primary tumors of the ureteropelvic junction have also been included, however, since they involve the ureter either from the beginning or very soon thereafter, and since they may produce radiologic changes similar to those seen when the tumor is located entirely within the ureter. The tumor has been considered as primary only when no concomitant or previous urinary tract tumors have been present.

In the past twenty years, 18 primary neoplasms of the ureter have been encountered in the Massachusetts General Hospital. Of these, 17 were carcinomas and 1 was an hemangioma. Eleven of the carcinomas were papillary in nature ("A"), 5 were invasive ("B"), and one was indeterminate. In one case only was the malignancy graded as I; in 12 as II, and in 3 as III. One was labeled as a rapidly growing undifferentiated carcinoma.

CLINICAL DATA

Of the 17 primary carcinomas, 9 were in males and 8 in females. The age of the patient at the time the diagnosis was made ranged from twenty-six to eighty-three years; the median age was sixty-three. The duration of symptoms varied from three days to five years, with an average of eight and a half months.

Hematuria, which was present in 16 cases (94 per cent), was by far the most common clinical sign. It was the first symptom in 11 cases (65 per cent) and the only one in 8 (47 per cent). The average time elapsing from its appearance to the patient's hospital admission was six to seven months. Other symptoms and signs included pain, weight loss, urinary frequency, dysuria, and in one instance a mass, the hydronephrotic kidney, felt by the patient. In one case the tumor was an incidental finding, having caused no symptoms.

[1] From the Department of Radiology, Massachusetts General Hospital, Boston 14, Mass. Accepted for publication in September 1950.

ROENTGEN FINDINGS

Plain film studies, though often unrevealing, may in many instances indicate some evidence of disease of the renal tract—enlargement of the renal outline or alteration in its shape due to hydronephrosis. In 2 of the 17 patients calculi were present along the course of the ureter: in one the calculus was found to be resting within the tumor bed, and in the other it was immediately below the tumor.

Excretory urograms were made in 14 cases. In 10 of these (71 per cent) there was failure of excretion by the kidney on the involved side; in the remainder, delayed excretion of contrast medium into a dilated calyceal system was observed. The ureter above the lesion was usually dilated and sometimes tortuous. These changes varied with the degree and duration of the obstruction caused by the tumor. On occasions the lower end of the column of contrast substance in the ureter showed an irregular, sharp cut-off, representing the upper edge of the tumor. It was evident that, even though no opaque medium could be seen on the side on which the lesion was located, the dye filling the bladder *via* the normal side at times outlined blood clots which had come from the involved ureter.

In general, visualization of the ureter by retrograde injection of dye offers the greatest opportunity for diagnosis. On many occasions the urologist may see tumor extruding through the ureterovesical orifice; often he may have difficulty in passing the catheter up the ureter or may encounter a complete obstruction. The roentgen appearance varies widely. Lesions which are small and do not cause obstruction to the retrograde flow of dye may appear as irregular or nodular filling defects projecting into the lumen. A similar appearance may be produced by slightly larger tumors located at the ureteropelvic junction, provided the portion of the tumor within the ureter does not cause complete obstruction. If retrograde flow of dye is obstructed, the roentgenogram will disclose a sudden sharp cut-off at the top of the dye column. The edges of this cut-off are often irregular or lobular. A fairly common appearance is that of an obstructing mass which enlarges the lumen of the ureter but permits the dye to flow partially around it, thus outlining its lower portion.

It frequently happens that the tumor, in addition to growing within the lumen for a greater or lesser distance, infiltrates and replaces the wall. In these instances, care must be taken, in searching for the main lumen of the ureter, to prevent the tip of the catheter from piercing the wall and causing extravasation of dye. Should this happen, the widened ureter may be outlined by the dye extravasated around it. If non-opaque filling defects are seen in close relationship to ureteral calculi, the diagnosis of tumor must be considered. A bizarre-appearing filling defect, or multiple defects over some length of ureter, should also be looked upon with great suspicion. In one of our cases the opaque medium flowed through approximately 7 cm. of widened ureter containing numerous filling defects, the whole pattern being reminiscent of the trabeculations seen in a chondroma or giant-cell tumor of bone. In some instances when the tumor causes obstruction to the downward flow of intravenous dye but not to the upward passage of the catheter, opaque medium may fill the calyces, pelvis, and ureter on the involved side down to and frequently outlining the upper edge of the mass. It is occasionally possible to determine the length of ureter involved in spite of obstruction to the flow of dye beyond it in either direction. Such was the situation in Case 5, where, by superimposition of the excretory and retrograde urograms, the actual length of the lesion could be determined.

LOCATION OF TUMOR

With the use of the information gained through plain films and excretory and retrograde examinations, the lesion was demonstrated in every one of this series. In 12 cases the tumor was on the right side; in 5 on the left. In 11 instances it

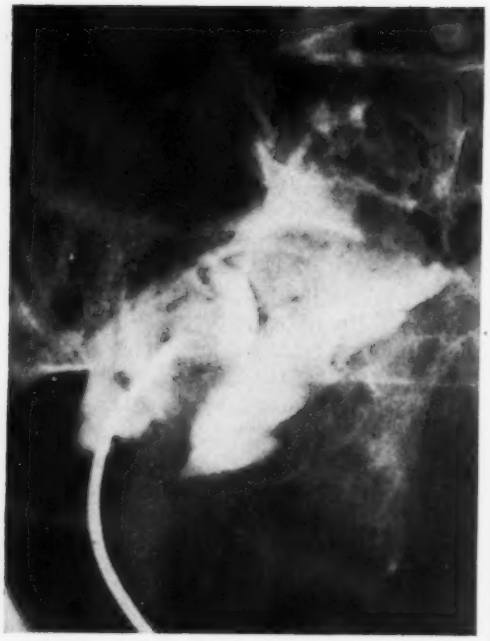

Fig. 1. Case 1. Arrest of catheter in obstructed right ureter.

lay in the lower third of the ureter; in 1 in the upper third; and in 3 it involved the ureteropelvic junction. In about one-half the group the tumor extended over a length of ureter varying from 2 to 5 cm.

CASE PRESENTATIONS

The histories of 8 cases of carcinoma of the ureter are presented to illustrate and emphasize particularly the roentgen features which are of help in arriving at a diagnosis. The details of a case of hemangioma of the ureter are included because of the rarity of this condition.

CASE 1: Male, 64 years. Nine months before admission, the patient had had an episode of right flank pain followed by gradual loss of weight and strength. Six weeks prior to entry, hematuria was noticed for the first time.

Excretory urography showed failure of excretion of dye from the right kidney. Catheterization was attempted, but the catheter was arrested at the point demonstrated in Figure 1. The dye pattern suggested extravasation of the dye, surrounding a dilated ureter. At *operation*, a hydronephrotic right kidney and dilated upper ureter were removed.

The hematuria continued, and two months later

Fig. 2. Case 2. Hydronephrosis with kinked, dilated ureter. Sudden cut-off of dye pattern at pelvic brim.

cystoscopy revealed a mass extruding from the right ureteral orifice. *Biopsy* showed carcinoma, Grade III A.

The remaining right ureter and a cuff of bladder were removed. The ureter was found to be completely occluded through its lower 4 cm. by firm tumor, the lower portion of which protruded through the ureteral orifice. *Histologic diagnosis:* Carcinoma, Grade II A.

CASE 2: Female, 62 years. Four weeks before admission the patient had experienced hematuria for a period of five days. Cystoscopy showed the bladder to be normal and dark brown urine coming from the right ureter.

An *excretory urogram* showed failure of the right kidney to excrete contrast substance. The catheter

Fig. 3. Case 3. Obstruction of right ureter, with curling of catheter.

Fig. 4. Case 4. Retrograde urogram showing peculiar looping of catheter at pelvic brim.

was passed beyond the ureteral obstruction and then withdrawn after injection of the dye. Figure 2 shows the hydronephrosis and kinked, dilated ureter extending down to the pelvic brim, where there is a sudden cut-off of the dye pattern.

Ureteronephrectomy was undertaken, but in an attempt to free the ureter at the pelvic brim it tore across, the lower end retracting so that it could not be tied. *Histopathology:* Hydronephrosis, hydroureter, pyelonephritis, ureteritis.

Hematuria recurred two weeks after the patient was discharged and persisted, necessitating readmission seven weeks later. Cystoscopy now revealed some tufts of tumor in the bladder and a fungating tumor near the right ureteral orifice. *Biopsy* showed carcinoma, Grade III A. A smooth firm, cord-like induration in the region of the remaining right ureter was felt on pelvic examination.

Exploratory laparotomy was done. The ureter was 1.5 cm. in diameter and very friable. There was considerable bleeding; the patient's condition deteriorated rapidly, and she died on the operating table. A specimen of the ureteral tumor was not removed for study, nor was permission for an autopsy obtained.

CASE 3: Female, 60 years. Three months before admission, following a fall, the patient had had a three-day bout of painless hematuria with small dark clots. There was no further bleeding until the day before entry.

On *roentgen examination*, the kidney outline was not clearly seen. An excretory urogram showed no excretion of dye from the right kidney in sixty minutes. The bladder contained lobulated filling defects representing blood clots. After retrograde injection of contrast medium, the ureter was seen to be dilated and to contain a pebbly-appearing filling defect. In Figure 3 it will be noted that there is obstruction to the upward passage of the catheter, with consequent curling.

Right ureteronephrectomy was done. The specimen revealed marked hydronephrosis and a smooth fusiform swelling of the lower ureter. The lumen contained a tumor 4 cm. in length and 1 cm. thick. The tumor extended to but not through the serosa. *Histopathology:* Carcinoma, Grade II A.

CASE 4: Male, 66 years. For one year the patient had had slowly progressive symptoms of prostatism, and for two months hematuria.

On the *excretory urogram* there was evidence of hydronephrosis on the left, with dilatation of the ureter down to the level of the upper sacrum. *Retrograde examination* (Fig. 4) showed a peculiar loop to the catheter in the region of the pelvic brim. Injection of contrast substance revealed a 6-cm. defect in the lower ureter. The column ended in a rounded, lobulated edge; in addition, there was extravasation around this portion of the ureter.

The kidney, ureter, and a cuff of the bladder were removed. Beginning 4.5 cm. above the lower end of

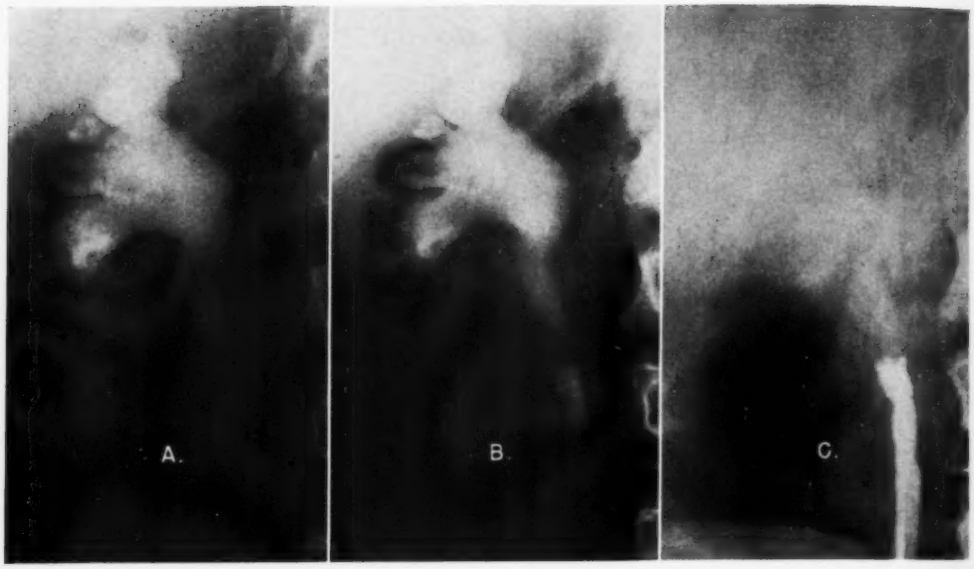

Fig. 5. Case 5. A. Excretory urogram. B. Composite of excretory and retrograde urograms. C. Retrograde urogram.

Fig. 6. Case 6 Ovoid filling defect demonstrated on attempted catheterization of left ureter.

the ureter and extending upward for 6 cm. the ureteral wall was thickened, with nodularity over this region of mucosa. *Histology:* Carcinoma, Grade II A.

CASE 5: Male, 68 years. Two months before admission the patient had passed a blood clot in the urine. There were subsequent intermittent episodes of hematuria. Cystoscopy was negative.

On *roentgen examination,* excretion on the right was found to be delayed. There were hydronephrosis and dilatation of the ureter to a point approximately 3 cm. below the ureteropelvic junction, where a fairly sharp but irregular lower edge to the column was observed (Fig. 5A). The retrograde examination (Fig. 5C) showed a nodular upper end of the dye column, beyond which no dye passed. Superimposition of the excretory and the retrograde pyelograms (Fig. 5B) showed the defect to measure approximately 2 cm. in length.

Nephro-ureterectomy was done. A nodular, superficially eroded lesion was located 2.5 cm. below the ureteropelvic junction, involving the circumference of the ureter. Its length corresponded to the defect in Figure 5B. The lesion invaded the wall of the ureter but did not extend into the surrounding fat. *Histology:* Carcinoma, Grade II B.

CASE 6: Male, 60 years. While receiving roentgen therapy for carcinoma of the soft palate and both anterior pillars, the patient complained of pain in the eye. A diagnosis of glaucoma was established, and while he was in the hospital undergoing treatment for this it was discovered that he had had painless hematuria for two weeks.

Excretory urography failed to show any contrast substance in the left kidney or ureter. On attempted catheterization of the left ureter, only the tip of the catheter entered it and but a small amount of the dye could be injected. This outlined an ovoid filling defect (Fig. 6).

Nephro-ureterectomy was done. A polypoid tumor extended for 3 cm. upward within the lumen, beginning at a point 5 mm. above the bladder orifice. The ureter above the tumor was moderately dilated and there was mild hydronephrosis. *Histology:* Carcinoma, Grade II A.

CASE 7: Female, age 68 years. The patient had had a gastrectomy for lymphoma of the stomach and omentum, following which pain developed in the left flank. One month after operation she noticed hematuria, and three days later she was admitted to the hospital. At cystoscopy the left ureteral catheter could be passed only 8 cm. upward.

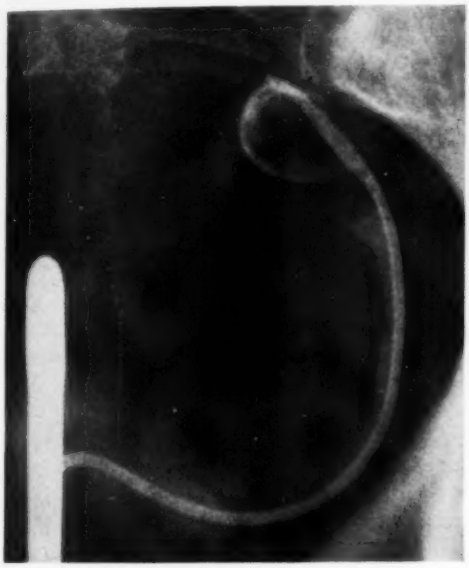

Fig. 7. Case 7. Retrograde urogram showing filling defect in left ureter overlying the sacroiliac joint.

Plain films were negative. *Excretory urograms* did not show any excretion on the left in one and a half hours. *Retrograde injection* of contrast substance (Fig. 7) disclosed a filling defect within the ureter overlying the sacroiliac joint. The ureter was widened at this level. (This is a point in favor of a diagnosis of tumor over blood clot.)

Nephro-ureterectomy was done. A soft mass was present within the lower ureter. Above the lesion the ureter was dilated and the kidney hydronephrotic. *Histology:* Carcinoma, Grade II A.

CASE 8: Female, 69 years. Fourteen months before admission the patient had experienced an episode of painless hematuria. Two weeks prior to entry there was a recurrence.

Retrograde injection of opaque medium showed good filling of the right renal calyces and pelvis (Fig. 8). There was an irregular, nodular, non-opaque filling defect in the lower pelvis and upper ureter.

Fig. 8. Case 8. Retrograde urogram showing good filling of right renal pelvis and calyces. There is an irregular, nodular, non-opaque filling defect in the lower pelvis and upper ureter.

A *pyelotomy* was done and a diagnosis of carcinoma was confirmed. Following this, *nephro-ureterectomy* was performed. *Histopathology:* Carcinoma, Grade II A.

CASE 9: Female, 42 years. The patient had had intermittent mild, painless hematuria for three years. Cystoscopy revealed a tumor which protruded from the left ureteral orifice with each peristaltic wave.

On *retrograde examination* (Fig. 9), the catheter tip lay just inside the ureter. Above it there extended an elongated smooth tubular filling defect around which the dye flowed upward for a distance of 11 cm.

A *cystotomy* showed a mass extruding from the left ureteral meatus. Slight tension resulted in a long cord-like structure being withdrawn from the ureter. The ureter was opened, but the mucosa appeared normal and the point at which the tumor had been attached could not be seen. *Histopathology:* Hemangioma.

DIFFERENTIAL DIAGNOSIS

The lesion which is most commonly confused with or which masks a tumor of the

Fig. 9. Case 9. Retrograde urogram showing elongated smooth filling defect above the tip of the catheter, which just enters the ureter.

ureter is ureteral calculus; occasionally a non-opaque stone may simulate tumor. Pain is usually associated with calculus but is less frequent with tumor and is of a different type. The failure of the "stone" to move up or down the ureter on repeated examination over a period of time should suggest the presence of a tumor. It should not be forgotten, however, that calculus and tumor may occur together. If an opaque calculus is present, associated with non-opaque filling defects, the diagnosis of tumor should be kept in mind.

Blood clot, by its irregular nature, may have an appearance identical with a ureteral tumor. In addition, a blood clot may also remain unchanged in position for a considerable time. Blood clot, however, rarely causes complete obstruction to the downward flow of fluid with subsequent failure of excretion of opaque medium, nor does it obstruct the upward passage of the catheter and/or dye. Blood clot is less likely than tumor to be associated with dilatation of the ureter.

Ureteral stricture may give a picture similar to that caused by an obstructing tumor, but in cases of stricture, congenital or otherwise, the degree of hydronephrosis and hydroureter is usually greater than is found with obstruction due to a tumor. This is probably to be explained by the fact that, because of the dramatic symptom of hematuria, the obstruction caused by a ureteral carcinoma is of relatively short duration.

Ureteritis cystica, due to the numerous small fluid-filled pockets, gives the appearance of widespread, pebbly filling defects. It does not obstruct the passage of urine, although it may be present in the ureter above an obstruction. Furthermore, it is often accompanied by a similar process in the bladder, visible on cystoscopy.

Tuberculous stricture of the ureter unassociated with evidence of other urinary tract involvement is rare, and its differentiation from tumor should cause little difficulty. In the former, involvement of the contralateral ureter and bladder is frequent, whereas in tumor this practically never occurs.

Since primary tumor of the ureter usually remains within its serosa for a long time, extending through the retroperitoneal tissues fairly late in its course, the discovery of a large retroperitoneal tumor in conjunction with ureteral involvement probably indicates secondary invasion by extrinsic tumor rather than primary carcinoma. One case was encountered in which the roentgen appearance simulated extravasation of dye through tumor-infiltrated wall; there proved to be a ureterovaginal fistula secondary to carcinoma of the cervix.

SUMMARY

Seventeen cases of primary carcinoma of the ureter have been reviewed, as well as a case of ureteral hemangioma. The history of the latter and of 8 of the former have been presented in some detail. The clinical

findings in this group of patients are in substantial agreement with those which have been described in the literature; hematuria is the outstanding common feature in the history.

Radiologically, failure of excretion of contrast substance by the kidney on the involved side is the rule or, if there is excretion, it is into a dilated renal pelvis and ureter, the dilatation in the latter extending down to the lesion.

The amount of diagnostic information secured from a retrograde examination depends on the degree of obstruction in the ureter and the amount of infiltration of its wall by tumor. A filling defect is nearly always outlined, and occasionally extravasation around the ureter at the tumor site is evident.

With the combined help of the clinical and radiologic findings, the diagnosis of ureteral tumor should be suggested or definitely made in practically every case.

Toronto General Hospital
Toronto, Ontario
Canada

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SUMARIO

Tumores Primarios del Uréter: Sus Características Roentgenológicas de Diagnóstico

Los casos repasados comprenden 17 de carcinoma primario del uréter así como uno de hemangioma ureteral. La historia de este último y de 8 de los primeros aparece con algún pormenor. Los hallazgos clínicos en este grupo de enfermos convienen substancialmente con los descritos en la literatura; la hematuria es la sobresaliente característica en común que contiene la anamnesia.

Radiológicamente, lo general es la falta de excreción de la substancia de contraste por el riñón del lado afectado, o, si hay excreción, es a una pelvis renal y uréter dilatados, extendiéndose hasta la lesión la dilatación del último.

La cantidad de información diagnóstica conseguida por un examen retrógrado depende de la magnitud de la oclusión del uréter y del volumen de infiltración de la pared del mismo por el tumor. Casi siempre se demarca un nicho, y de vez en cuando se divisa extravasación periureteral en el sitio del tumor.

Con la ayuda combinada de los hallazgos clínicos y radiológicos, debe sugerirse o hacerse definitivamente el diagnóstico de tumor ureteral en casi todos los casos.

Pancreatitis: Its Preoperative Diagnosis by Gastro-Intestinal Roentgenography[1]

CHARLES GOTTLIEB, M.D., MILTON DORFMAN, M.D.[2], and HUGH A. CREGG, M.D.
New York, N. Y.

SINCE FROSTBERG first called attention to the inverted "3" sign as diagnostic of duodenal intrusion by pancreatic enlargement, many authors have described the indirect gastro-intestinal changes in disease of the pancreas. The following radiographic changes are considered suggestive of a pancreatic lesion, most of them representing distorted configurations of the duodenum produced by the enlarged pancreatic head: (1) inability to fill a segment of the descending duodenum with barium; (2) narrowing of a segment of the descending duodenum; (3) dilatation of a segment of the duodenum, with flattening, narrowing, or non-filling distally; (4) coarsening of duodenal folds, or complete effacement of folds on the pancreatic side, due to edema, hyperemia, or neoplastic invasion; (5) flattening of the valvulae conniventes by the enlarged pancreas; (6) deformity of the duodenal bulb or the antrum of the stomach on the posterior and greater curvature side; (7) widening of the duodenal

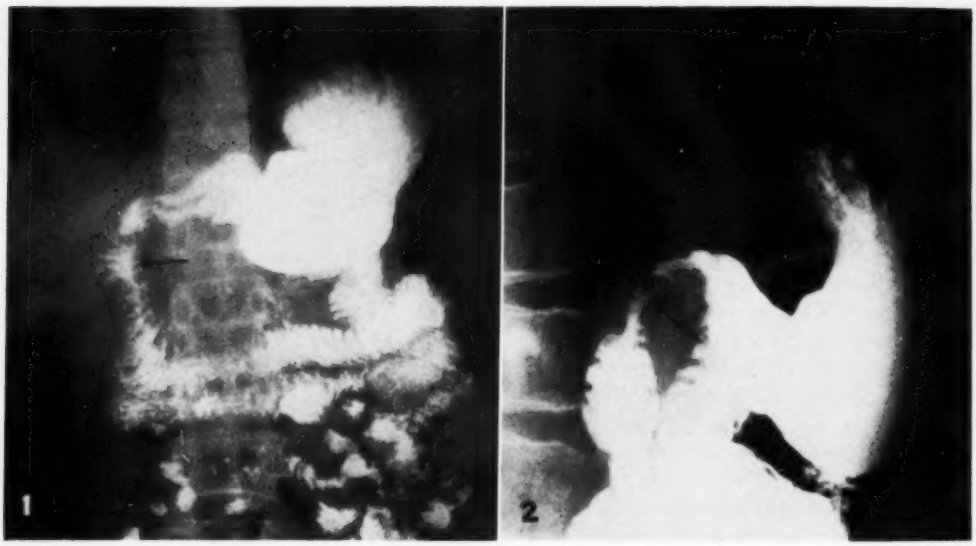

Fig. 1. Case I. Flattening of valvulae conniventes by hard, lobular, fibrotic pancreas.
Fig. 2. Case II. Narrowing, flattening and obliteration of mucosal pattern with evidence of extrinsic pressure defect due to a hemorrhagic inflamed pancreatic head.

the sweep, or straightening of the medial margin; (8) retention of barium in the duodenum after six hours; (9) a deficiency type of small bowel pattern; (10) localized ileus in the jejunum, duodenum, or middle transverse colon.

In the 9 cases to be reported here, various changes secondary to pancreatitis were observed, but it is noteworthy that the common denominator in most instances was

[1] From the Department of Radiology, New York University-Bellevue Medical Center, University Hospital, New York. Accepted for publication in September 1950.
[2] Now Associate Radiologist, Department of Radiology, Veterans Administration Hospital, Des Moines, Iowa.

encroachment of the enlarged pancreas on the duodenum. While we are unable in a given case to determine the exact histopathologic nature of the lesion responsible for these roentgenologic manifestations, it has been possible for us to direct the attention of the clinician to the probability of pancreatic disease. All of the patients in our series had pancreatitis, proved at operation or autopsy. It is impossible, however, by roentgen methods alone to differentiate between tumor and inflammation. The same radiographic criteria apply to both.

Fig. 3. Case III. Deformed bulb and ulcer niche; flattening of valvulae conniventes with extrinsic pressure by indurated, inflamed pancreatic head, which formed the ulcer bed.

CASE REPORTS

CASE I (Fig. 1): M. A. M., a 34-year-old white male, complained of pain in the back and epigastrium of six years duration. A gastro-intestinal series showed a pressure defect and flattening of the valvulae conniventes on the concave side of the proximal portion of the pars descendens duodeni. It was noted that two calculi were present in the region of the head of the pancreas. The *roentgen diagnosis* (preoperative) was extrinsic pressure on the duodenum, probably due to pancreatitis.

At operation the pancreas was found to be hard and lobular throughout. Biopsy showed chronic pancreatitis with fibrosis. The duodenum was opened; the ampulla of Vater was edematous and firm. The sphincter of Oddi was cut under direct vision. The gallbladder, which was removed, contained no stones and was normal.

CASE II (Fig. 2): F. W., a 53-year-old white male,

Fig. 4. Case IV. Obstructing duodenal ulcer. Pars descendens duodeni is narrowed, with obliteration of the mucosal pattern and extrinsic pressure defect caused by a locally hardened pancreatic head, which constituted the base of the ulcer.

was admitted complaining of a retrosternal burning sensation of three weeks duration. The distress was relieved temporarily by food. Gastro-intestinal examination showed a narrowing of the duodenum with flattening to absence of the mucosal pattern and an extrinsic pressure defect extending through the proximal portion of the pars descendens. The *roentgen diagnosis* (preoperative) was enlargement of the pancreatic head with encroachment on the duodenum.

The patient died three days after an esophagoscopy. Postmortem examination showed no intrinsic duodenal lesion. The valvulae conniventes were flattened in the proximal portion as compared to the distal portion. The head of the pancreas was enlarged and hard. Microscopic examination showed acute hemorrhagic pancreatitis.

CASE III (Fig. 3): M. C., a 56-year-old white female, was admitted with localized pain in the epigastrium, in the lumbar spine, and in the left shoulder. She had had several episodes of vomiting. For twenty years she had suffered from recurrent epigastric and generalized lower abdominal pains. She had never had any jaundice.

A gastro-intestinal series showed a small, irregular, deformed duodenal bulb with a niche in its mid-portion. The post-bulbar area was narrowed, with obliteration of the mucosal markings and evidence of extrinsic pressure. A gallbladder series was not remarkable. The *roentgen diagnosis* (preoperative) was pancreatitis secondary to a penetrating duodenal ulcer.

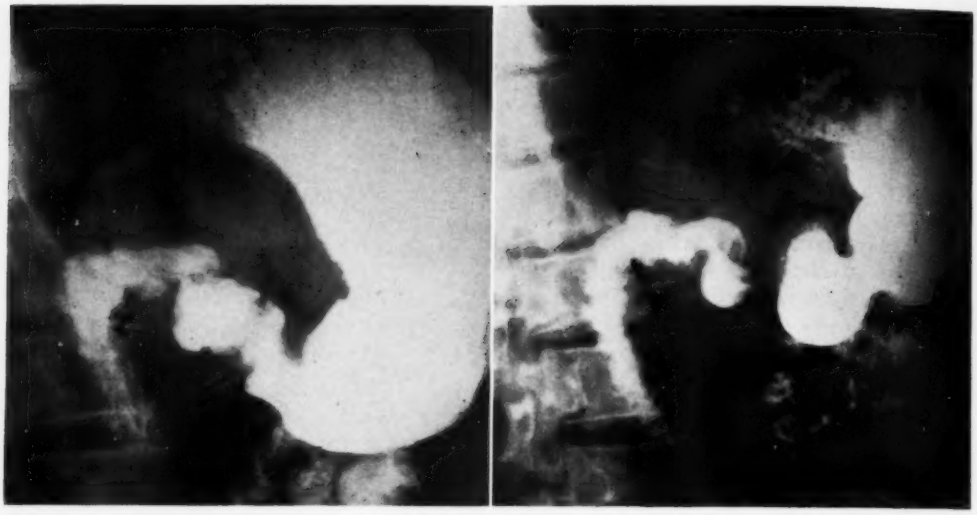

Fig. 5. Case V. Posterior penetrating duodenal ulcer concomitant with pressure defect due to the secondarily inflamed pancreas.

Fig. 6. . Case VI. Pancreatic intrusion into descending duodenum. Proved to be a pancreatitis secondary to a flat, undemonstrated duodenal ulcer.

At operation the gallbladder and common duct were found to be normal. The duodenum showed a hard indurated inflammatory lesion on the medial border between the first and second portions. The ulcer penetrated into the head of the pancreas. Subtotal gastrectomy was done.

CASE IV (Fig. 4): B. P., a 52-year-old white male, entered the hospital because of hematemesis twenty-four hours earlier. He had a past history of postprandial distress, with occasional tarry stools, of eleven years duration.

A gastro-intestinal series showed an obstructing duodenal ulcer. The descending duodenum was narrow and irregular, especially on the medial aspect. There was marked duodenal distention, beginning at the junction of the pars descendens and pars horizontalis and continuing to the duodenojejunal junction. At six hours there was a 25 per cent gastric residue plus stasis in the duodenum. The *roentgen diagnosis* (preoperative) was deformity of pars descendens duodeni plus duodenal distention secondary to pressure by an enlarged pancreas; probable pancreatitis secondary to duodenal ulcer.

At operation the duodenum was found to be scarred and adherent to the pancreas; the head of the pancreas formed the base of the duodenal ulcer and was locally hardened. Subtotal gastrectomy was done.

CASE V (Fig. 5): G. E., a white male 61 years of age, was admitted with pain in the abdomen and back, of two weeks duration. Mid-epigastric pain radiating to the right upper quadrant and mid-back had suddenly developed, accompanied by vomiting of green and bitter fluid. The pain gradually subsided within the next two days.

Good visualization of the gallbladder was obtained, with no evidence of stones. A gastro-intestinal series showed a niche in the duodenal cap, penetrating into the pancreatic bed. The duodenum was narrow, with absence of mucosal pattern and an extrinsic pressure defect on the inner aspect of the descending limb. At six hours a static fleck was present at the base of the duodenal bulb. The *roentgen diagnosis* (preoperative) was pancreatitis secondary to a penetrating duodenal ulcer.

At operation a large posterior duodenal ulcer was found penetrating into the head of the pancreas.

CASE VI (Fig. 6): J. G. R., a 40-year-old white male, while in the hospital, suffered a severe back pain relieved by opiates and unrelated to position or type of food. Serum amylase was 1.7 mg. per c.c. (normal) and lipase 0.1 c.c. (normal).

A gastro-intestinal series showed narrowing of the duodenum just beyond the bulb, with evidence of extrinsic pressure on the medial aspect of the pars descendens and erasure of the mucosal markings. The *roentgen diagnosis* (preoperative) was enlarged pancreatic head, probably due to pancreatitis.

At operation, a 3 cm. nodular area of pancreatitis was found involving the head and the neck of the pancreas. The area was rubbery, indurated, and with occasional foci of fat necrosis. There was some scarring of the first portion of the duodenum, indicating a chronic duodenal ulcer. There was also an ulcer of the second portion of the duodenum close to the ampulla, penetrating into the head of the pancreas. Subtotal gastrectomy was performed.

CASE VII (Fig. 7): J. G. B., a 40-year-old white male, was admitted with back and stomach pain of five months duration. There was a history of hema-

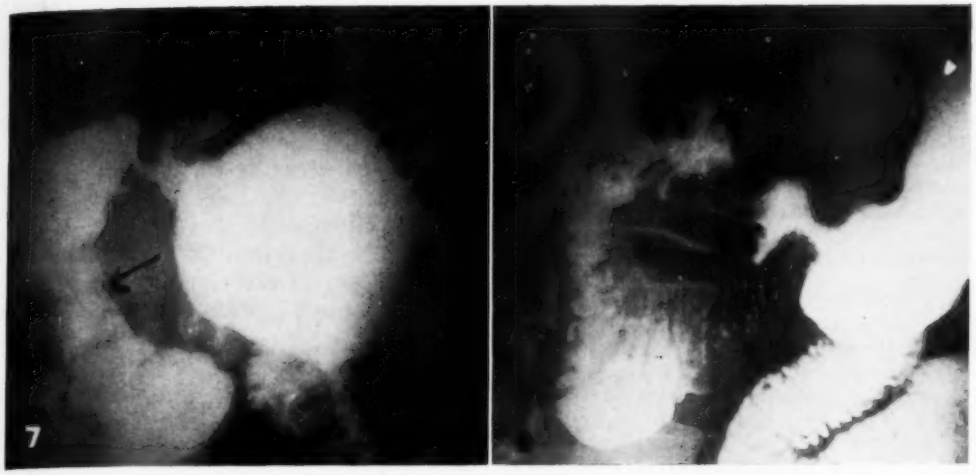

Fig. 7. Case VII. Dilated descending duodenum with flattening on pancreatic side due to chronic pancreatitis secondary to penetrating duodenal ulcer.

Fig. 8. Case VIII. Anteroposterior pressure upon transverse duodenum causing secondary dilatation of descending duodenum concomitant with flattening of valvulae conniventes due to chronic pancreatitis.

temesis and tarry stools nine years before this admission. Intermittent episodes of epigastric and back pain were relieved by food. Seven months before admission there had been a second episode of hematemesis and tarry stools, after which the symptoms increased in severity.

A gastro-intestinal series showed a deformed duodenal bulb with an ulcer niche penetrating into the pancreatic head; post-bulbar narrowing with distention distally; evidence of extrinsic pressure upon the pars descendens. There was 20 per cent gastric retention at the end of six hours. The *roentgen diagnosis* (preoperative) was pancreatitis secondary to a penetrating duodenal ulcer.

At operation, a duodenal ulcer penetrating into the pancreas with resultant chronic pancreatitis was found.

CASE VIII (Fig. 8): M. O., a 31-year-old white male, was admitted with intermittent pain in the epigastrium radiating to both upper quadrants. He had first experienced this pain three months before admission. It was aggravated on lying down, and seemed at times to bore through the epigastrium to the interscapular area. There was definite tenderness in the epigastrium.

The gallbladder could not be visualized. A gastro-intestinal series showed a distended, dilated pars descendens with effacement of the mucosal folds. An extrinsic pressure defect was observed on the pars horizontalis. At six hours a small amount of barium remained in the pars descendens. The *roentgen diagnosis* (preoperative) was enlargement of the pancreas with extrinsic pressure on the pars horizontalis.

Cholecystitis, cholelithiasis, and chronic pancreatitis were found at operation.

Fig. 9. Case IX. Marked dilatation of descending and transverse duodenum due to pressure on intestine at duodenojejunal junction by a chronic fibrosing pancreatitis.

CASE IX (Fig. 9): H. D. P., a 27-year-old white female, entered the hospital with epigastric distress. Thirteen months before admission, during the fifth month of her second pregnancy, she complained of a squeezing, pressing sensation in the epigastrium. The pain was relieved by alkalis, but not by food.

There were occasional episodes of vomiting. In the last three months before admission the patient had repeated, vague, dull, aching low back pain lasting several hours.

A gastro-intestinal series showed pronounced distention of the second and third portions of the duodenum. There was evidence of flattening from extrinsic pressure just proximal to the duodenojejunal junction. At six hours there was stasis of barium in the distended duodenal loop. The *roentgen diagnosis* (preoperative) was enlargement of the pancreas with extrinsic pressure on the duodenum.

At operation an enlarged firm pancreas was found, with mottled yellowish areas of fat necrosis, particularly in the head of the pancreas and retroperitoneal space. The common duct was not dilated. The gallbladder was normal. The liver and stomach were normal. The duodenum was much distended and dilated. There was a chronic fibrosing pancreatitis with beginning calcification and resultant obstruction at the duodenojejunal junction. Compression of this portion of the intestine against the spine was due to the weight and fixation of the pancreas. A duodenojejunostomy was done.

DISCUSSION

We have found the following roentgen signs to be highly suggestive of pancreatic disease: flattening of the valvulae conniventes, extrinsic pressure on the duodenum, variable narrowing of the duodenum accompanied by effacement of the normal mucosal markings, and distention of the proximal duodenal loop due to obstruction of the duodenojejunal junction by an enlarged firm pancreas.

Correlation of such roentgen evidence of pancreatic enlargement with the available clinical data makes possible more accurate determination of the nature of the pancreatic disease. Since both duodenal ulcer and cholelithiasis are known precursors of pancreatitis, clinical evidence of either, plus radiographic signs of duodenal encroachment, are good indications of pancreatic inflammation. If the patient gives a history of the development of back pain, in addition to the original ulcer or gallbladder symptoms, this too is suggestive. It is occasionally possible to visualize pancreatic lithiasis, which is an additional sign of pancreatitis.

If radiography demonstrates an encroachment or a suggestion of extrinsic pressure on the duodenum, and the nature of the enlargement is in doubt, the case is reported as "pancreatic enlargement, cause unknown." Carcinoma of the pancreas and undemonstrated duodenal ulcers fall within this group. We have not as yet demonstrated early carcinoma, but we have reported pancreatitis where the duodenal ulcer consisted of a hole in the duodenum whose opening was sealed by the pancreas. This type of ulcer most probably could not be demonstrated with the usual method of examination.

DIFFERENTIAL DIAGNOSIS

The normal ampulla of Vater may appear as an oval or circular filling defect in the pars descendens duodeni. In profile, the appearance simulates the changes described above as the result of pancreatic pressure. The roentgenographic features, however, are those of an intramural, extramucosal benign mass, differentiating the defect from that due to the pancreas. Primary ampullary carcinoma, on the other hand, results in destruction of the duodenal mucosal pattern and frequently, in its early stages, causes concomitant localized bulging of the duodenal lumen. Furthermore, an ampullary carcinoma may be accompanied by a distended gallbladder, the fundus of which indents the lateral aspect of the descending limb of the duodenum. This latter roentgenographic finding serves to differentiate ampullary lesions from pancreatic head enlargement. The early unremitting jaundice is a further aid in diagnosis.

Ectopic pancreatic tissue in the wall of the duodenum leads to either single or multiple filling defects, each of which again has the characteristics of an intramural, extramucosal mass. If the defects are multiple, this observation alone is sufficient to rule out enlargement of the head of the pancreas. Also, the filling defects seen in profile appear as indentations which frequently are haphazard in distribution and involve the lateral as well as the medial aspects of the descending duodenum. In like manner, paraduodenal lymph node disease, whether inflammatory

or neoplastic, will produce evidence of extrinsic pressure on the descending duodenum, but these indentations again are located both on the lateral and medial aspects and are characterized by the presence of intervening uncompressed duodenal mucosa.

Primary carcinoma of the duodenum will produce the changes of an intraluminal mucosal mass if it is polypoid in character. A stenosing type will cause a persistent narrowing of the duodenal lumen, leading to obstructive symptoms. In any case, the duodenal mucosal pattern is destroyed at the tumor site, and the characteristic roentgen features of a malignant new growth should be sought.

Pancreatic carcinoma strategically located produces all the roentgen manifestations of enlargement of the head of the pancreas. The differential diagnosis between carcinoma and inflammatory disease rests strongly upon the clinical findings. Our Case IV showed the classical inverted "3" sign usually ascribed to pancreatic carcinoma, but later events proved it to be secondary to pancreatitis. The roentgen diagnosis of pancreatitis in this case rested on a careful correlation of the roentgenographic and clinical findings. As stated previously, the findings described are secondary to pancreatic enlargement and no more specific diagnosis may be made without other roentgenographic and/or clinical observations.

Retroperitoneal masses result in gross deformity and displacement of the duodenal sweep. Supplementary roentgenographic, clinical, and surgical data may be required for a specific diagnosis.

Persistence of the hepatico-duodenal-colic ligament produces the classical linear oblique filling defect across the proximal duodenum and presents no problem in differential diagnosis. The superior mesenteric syndrome, however, is characterized by an extrinsic obstructing band or vessel across the pars horizontalis producing dilatation, distention, and retention of contrast meal in the proximal portion of the duodenum. The roentgenographic picture simulates the findings in our Cases VIII and IX. Usually, obstruction is at the midline in the superior mesenteric syndrome; our cases presented evidence of extrinsic mass pressure more distally, near the duodenojejunal junction.

SUMMARY

Nine cases of pancreatic enlargement due to pancreatitis have been presented. All of these showed indirect roentgen signs of pancreatic disease, due in most instances to encroachment of the enlarged pancreas on the duodenum. Though a specific diagnosis cannot be made solely on the roentgen findings, attention to these indirect signs will permit a more positive approach to the diagnosis of pancreatic lesions.

303 East 20th St.
New York 3, N. Y.

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SUMARIO

Pancreatitis: Diagnóstico Preoperatorio por la Radiografía Gastro-Intestinal

Los 9 casos descritos son de hipertrofia del páncreas debida a pancreatitis, discutiéndose los signos roentgenológicos indirectos que sugieren la existencia de pancreopatía. Son los siguientes: aplanamiento de las válvulas conniventes, presión extrínseca sobre el duodeno, estrechez variable del duodeno acompañada de desaparición de las marcas normales de las mucosas y distensión del asa duodenal proximal debido a oclusión de la unión duodenoyeyunal por un páncreas hipertrofiado y duro.

La diferenciación entre carcinoma del páncreas y lesiones inflamatorias se basa en gran parte en las observaciones clínicas. Visto que tanto la úlcera duodenal cuanto la colelitiasis son conocidos precursores de la pancreatitis, la demostración clínica de una u otra, unida a los signos radiográficos de compromiso duodenal, constituyen indicaciones de inflamación pancreática.

Sex Hormones and Castration in Advanced Breast Cancer[1]

IRA T. NATHANSON, M.S., M.D.

THE PAST DECADE has ushered in new concepts of the etiologic and therapeutic aspects of neoplastic diseases. Chemotherapeutic technics have received particular attention. Notable among the strides that have been made is the concrete demonstration that certain hormones may significantly influence the course of mammary and prostatic cancer and possibly also of neoplasms arising in other organs subjected to endocrine influences (1–6). The implications are of paramount importance and have served to stimulate intensive investigations into the possible mechanisms involved. Of practical consideration is the application of this new information in the management of potentially "hormone-susceptible" cancers. This discussion will consider specifically hormones in the therapy of breast cancer.

I. INDICATIONS FOR HORMONAL THERAPY OF BREAST CANCER

Surgery and irradiation remain the optimum methods available for permanent or palliative control of localized and accessible manifestations of breast cancer. The potentialities of hormonal therapy, however, are becoming increasingly obvious and better defined. As a result, hormones can now be considered as a third method of attack, but only from the standpoint of palliation. Hormone therapy may be utilized as (*a*) an initial therapeutic measure for selected advanced primary lesions beyond the scope of effective surgical or radiological attack, (*b*) an adjunct to the established methods, or in combination with them, particularly when the manifestations are disseminated and beyond the practicability of locally directed treatment, (*c*) a secondary procedure for cancer initially treated to the fullest extent by surgery or radiation but no longer amenable to either method.

II. METHODS AND EFFECTS OF HORMONAL THERAPY

(*A*) *Castration:* Although there is still disagreement concerning the role of castration in the management of breast cancer, and the optimum time for its performance, a practical working plan has emerged. The beneficial effects are essentially confined to premenopausal women, though occasionally castration appears to be of value a few years after spontaneous cessation of the menses if there is evidence of residual ovarian activity. In the male, by contrast, orchiectomy seems to be more efficacious in older individuals with advanced breast cancer (7, 8).

Castration is primarily of value as a palliative procedure (9, 10). Present data do not indicate that it is significantly advantageous as a prophylactic measure in conjunction with radical mastectomy if the latter is performed with the expectancy of control of the disease. Beneficial effects of castration, whenever instituted, are of limited duration. Thus, the trend is to withhold the procedure for treatment of manifestations beyond effective control by the usual methods. In this way, further benefit may be obtained and the life expectancy of the patient may possibly be prolonged.

Effects of Castration: Primary, lymphatic, and other soft-tissue lesions of breast cancer in the female may undergo profound regression, and osseous lesions may calcify following castration (1, 4, 5). Improvement in physical status, rehabilitation, re-

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lief of pain, and increase in appetite and weight usually accompany but may occur without obvious local responses. Hemopoiesis may increase when there is an anemia secondary to osseous involvement. Both objective and systemic effects are usually more striking following orchiectomy in cancer of the breast in the male (8).

The potential effects of castration are clouded by the technics employed. It is obvious that methods short of ovariectomy do not permit critical analyses of the efficacy of complete suppression of gonadal function. In order to establish a base line this is essential. Both ovariectomy and irradiation of the ovaries have been employed. Surgery essentially guarantees permanent eradication of ovarian hormone production and ovulation; the efficacy of radiation in these respects is less certain.

The effect of varying degrees of ovarian suppression on breast cancer may be dependent upon activities or adjustments of the internal secretions of other endocrine organs. Therefore, knowledge of the state of gonadal function is of prime importance for evaluation of responses which may be seen in the tumor. The development of amenorrhea and menopausal symptoms following irradiation of the ovaries is not a sufficient criterion of the completeness of ovarian suppression. Studies of urinary gonadotropins, estrogen excretion, and vaginal smears after ovarian irradiation not infrequently reveal considerable fluctuation as contrasted to relatively constant levels after ovariectomy (11). These variations are noted even with cessation of the menses and the occurrence of hot flushes. Furthermore, even though ovarian function appears to be completely suppressed following irradiation, as judged by the above criteria, the menses may reappear and the menopausal symptoms vanish, thus indicating functional recovery.

It is now clear that failure to suppress ovarian function completely and permanently by irradiation is due in part to insufficient dosage. The effective dose level is higher in younger women because of greater ovarian activity. There is good evidence that an adequate radiation dosage may be as efficacious as ovariectomy. Because of the uncertainty, however, there has been a trend in our clinics toward ovariectomy for younger women wherever possible, radiation being reserved primarily for women in the forties, when ovarian function is beginning to decline.

When irradiation is employed, its effectiveness can be judged by serial studies of the vaginal smear. With routine dosages, effective suppression of ovarian function in the average patient, as shown by laboratory and clinical evidence, does not occur before a minimum of six to eight weeks after the initiation of irradiation (11). Whether this interval is shortened, or if suppression of ovarian function is complete with larger dosages of radiation, is not yet known. In any event, ovariectomy is preferable if a rapid effect is necessary because of acute and disabling symptoms. The role of testosterone in hastening radiation suppression of ovarian function will be discussed later. It is possible that complete ablation of ovarian function is not desirable. Favorable effects on breast cancer by apparently inadequate radiation to the ovaries are not infrequently seen. This may be due to a suppression of the sensitive estrogen-producing follicular apparatus without an effect on the relatively radioresistant stromal elements that appear experimentally to be a source of androgenic hormones.

There is little doubt that orchiectomy is much more effective than irradiation in obliterating testicular activity. Moreover, reactions in the sensitive scrotum which may accompany irradiation are to be contrasted to the slight risk attending orchiectomy even in patients who are in poor general condition.

The majority of reports indicate that from one-fourth to one-third of female patients with advanced breast cancer will derive some benefit from castration. Respites following castration last from a few months to several years. Although the number of cases is small, the degree and

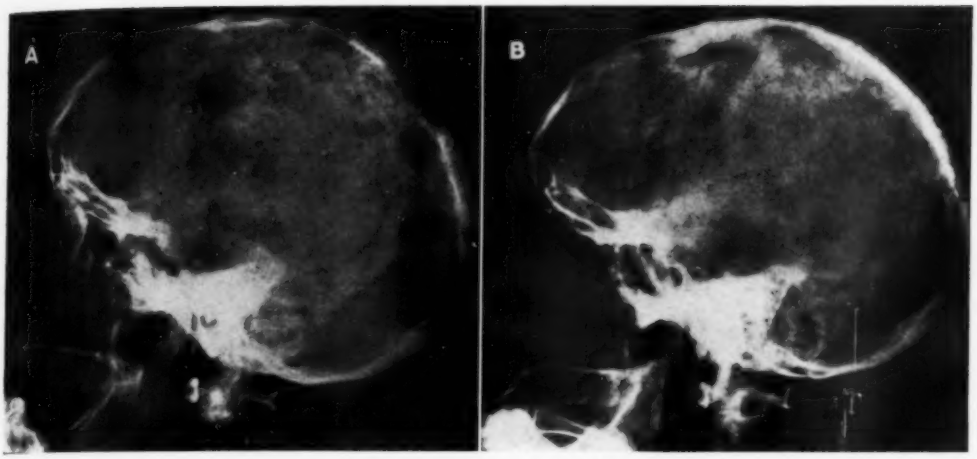

Fig. 1. M. S., age 56. A. Osteolytic metastases before treatment. B. After ten months treatment with androgens.

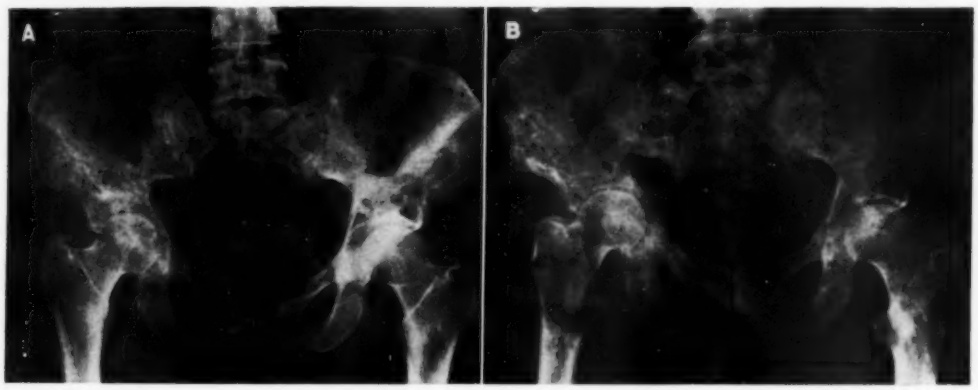

Fig. 2. M. P., age 50. A. Osteolytic lesions before treatment. B. Four months after onset of androgen therapy. Note marked increase in disease.

duration of favorable responses in the male, following orchiectomy, appear to be greater (7, 8).

The earlier studies on the effectiveness of ovarian irradiation in breast cancer must be re-evaluated because the dosages employed were frequently inadequate to suppress the essential elements of ovarian hormonal function. That this is becoming better recognized is evidenced by recent trends toward the delivery of larger and more efficient doses of radiation.

(*B*) *Androgens:* Androgens may be utilized as palliative agents for advanced breast cancer in women in any stage of life (12–16). The effectiveness of the treatment appears to be dependent upon the site of the lesions and, to a limited extent, upon the age of the patient. Androgens have also been used prophylactically after radical mastectomy in an attempt to prevent recurrence and to increase life expectancy. Information available on the point is limited, but increased survival rates have been reported in patients with axillary lymph node metastases (17). This aspect particularly needs further investigation.

Effects of Androgen Therapy (*Table I*): Androgens appear to be most efficacious in

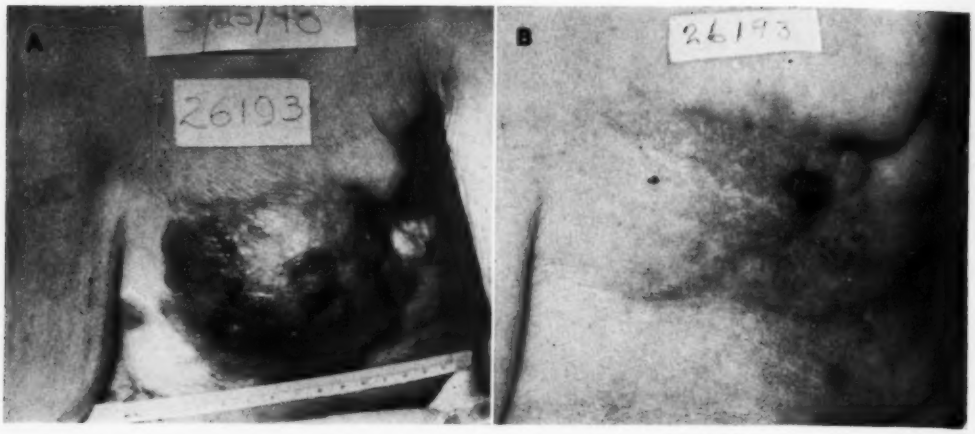

Fig. 3. M. M., age 71. A. Massive carcinomatous involvement of left breast. B. Appearance after two years of continuous estrogen therapy.

TABLE I: COMPARATIVE EFFECTS OF ESTROGENS AND ANDROGENS ON VARIOUS MANIFESTATIONS OF BREAST CANCER

	Estrogens (253)*		Androgens (105)*	
	Per Cent	No.	Per Cent	No.
Subjective improvement (well-being)	35.0	(154)	73.8	(103)
Pain relief (osseous metastases)	42.9	(70)	81.5	(92)
Primary lesion	50.5	(95)	14.2	(14)
Soft-tissue metastases	44.6	(197)	22.7	(66)
Lung metastases	40.0	(55)	7.6	(26)
Osseous metastases	22.6	(84)	23.4	(94)

* Figures in parentheses represent total number of cases with specific signs or symptoms.

breast cancer in the production of favorable effects on osseous metastases and the symptoms referable to this manifestation of the disease. After androgen therapy osteolytic metastases from breast cancer calcify in from one-fifth to one-fourth of patients of whatever age (Fig. 1). In some instances, as the original lesions apparently continue to improve, new progressive osteolytic lesions are noted. Under other circumstances, rapid progression of existing osseous lesions may occur, especially if the patient is confined to bed. Regressions of soft-tissue lesions, although less obvious, are most frequent in women in the premenopausal and menopausal eras.

Symptomatic improvement, consisting of pain relief, increase in appetite and weight, and rehabilitation, is seen in a high percentage of patients treated with androgens, particularly when osseous metastases are present. Of interest is the considerable discrepancy between the subjective and objective improvement in any series of cases. Actually, it is not unusual to observe continued progression or apparent acceleration of the disease in spite of excellent symptomatic relief (Fig. 2). Coincident with other beneficial effects, there may be an improvement in an existing anemia secondary to bone marrow involvement.

The duration of favorable responses is variable but in the majority of cases recrudescence of the signs and symptoms appears within a year. A number of patients, however, have experienced sustained and striking benefits for several years. In premenopausal women, castration is generally more efficacious than androgen therapy, presumably because of more complete suppression of ovarian function.

(*C*) *Estrogens:* Estrogens are indicated primarily for advanced primary breast cancer and its distant deposits in postmenopausal women, regardless of the chronologic age of the individual (18). The best results, however, are generally obtained in elderly patients. Acceleration of

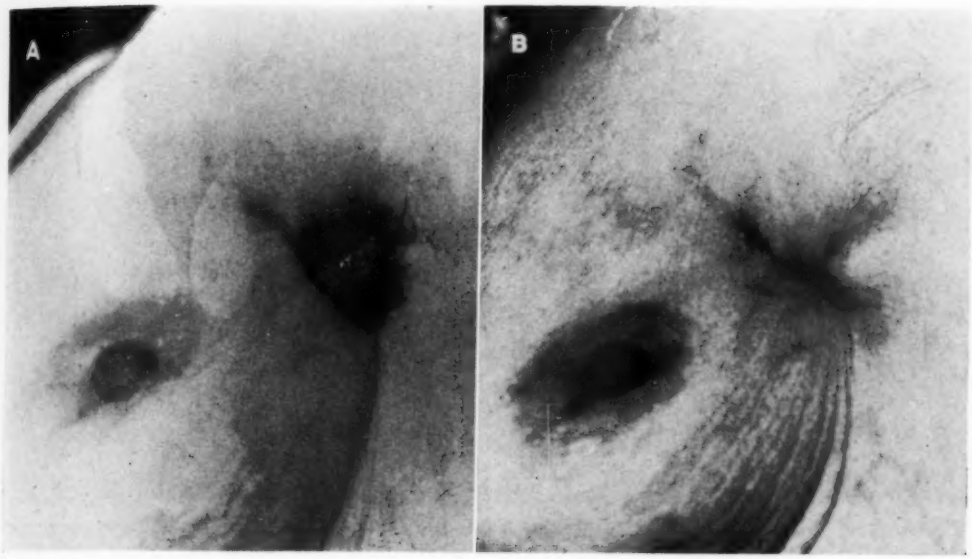

Fig. 4. J. N., age 70. A. Carcinomatous ulcer, axillary fold, left breast, before treatment. B. Healing after three months of estrogen therapy.

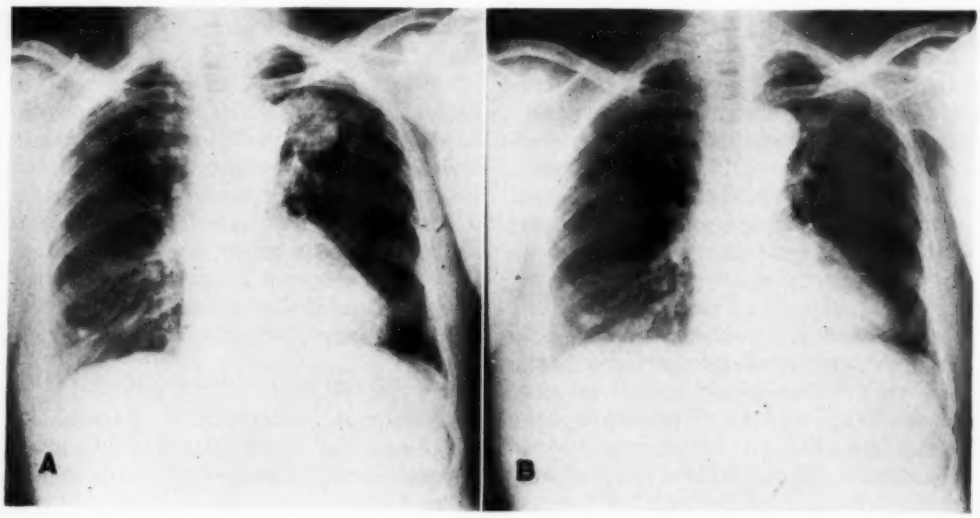

Fig. 5. D. R., age 55. A. Large pulmonary metastasis, left upper lung field. B. Status after two months of estrogen therapy.

the disease may occur in premenopausal women, while in the menopausal group variable responses ranging from acceleration to remission may be observed. With these limitations, estrogens may favorably influence every manifestation of breast cancer (5, 6, 15, 16, 19–22).

Effects of Estrogen Therapy (Table I): The most obvious effects of estrogens are on the soft-tissue lesions of breast cancer, in which responses occur with greater frequency and are better defined than those seen after androgen therapy. Ulcerations may heal, and gross masses, lymph node,

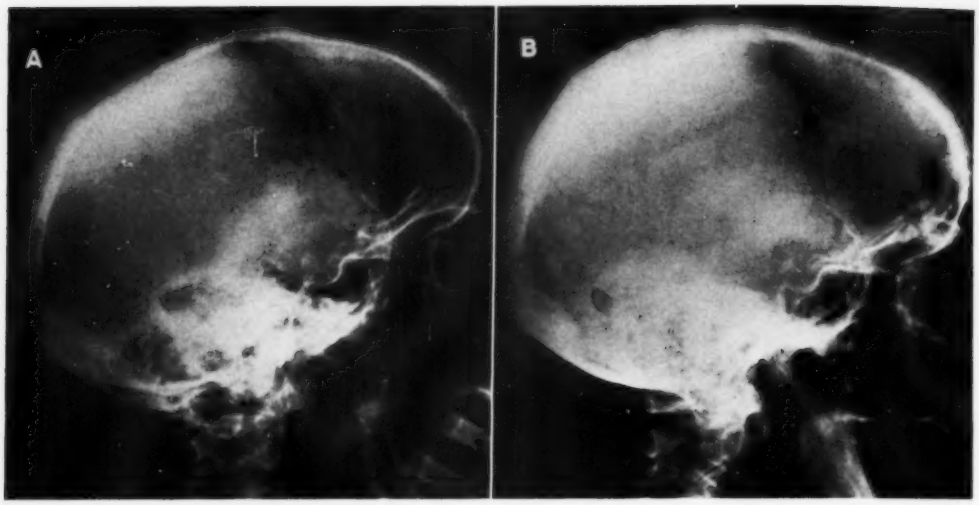

Fig. 6. L. B., age 63. A. Osteolytic metastases, left frontal and parieto-occipital areas. B. Degree of calcification, after ten months of continuous estrogen therapy. Note apparent generalized increase in calcification in the skull.

pulmonary, and hepatic metastases may diminish considerably in extent. In some instances the lesions become barely detectable (Figs. 3–5). Palpable masses frequently assume a fibrotic resilient character even without significant reduction in size. Of especial significance is the fact, that osseous lesions in postmenopausal women may calcify in essentially the same order of frequency as with androgen therapy in women of any period of life (6, 16, 23) (Fig. 6).

Estrogens may likewise exert a favorable influence on advanced breast cancer in the male, when employed either as a primary therapeutic agent or for reactivation of the disease following an initial response to orchiectomy. On the basis of the relatively few cases treated, initial orchiectomy appears to be more efficacious (24).

Symptomatic improvement usually accompanies the objective favorable effects of estrogen therapy. The subjective and systemic responses are similar to those with androgen therapy, but do not occur as frequently or as rapidly. In contrast to androgen therapy, however, there is considerably less discrepancy between the subjective and objective responses.

As with the other technics, the duration of beneficial effects are temporary, but in some cases respites have been maintained for several years.

(*D*) *Other Hormones:* Progesterone, cortisone, and adrenocorticotropic hormone are being tried as possible methods of treatment of breast cancer. The data are too few at present for critical evaluation. In some cases, however, suggestive alterations have been noted, so that a thorough investigation of the potentialities of these hormones is indicated (25–28).

III. GROSS AND MICROSCOPIC ALTERATIONS

Considerable alteration in the gross and histologic characteristics of the various forms of breast cancer and the stroma may occur following hormonal therapy or castration. These will be reported in detail elsewhere and will include the work of other investigators (29). The salient features, however, may be summarized here. Our observations are based primarily on material from a large series of estrogen-treated cases consisting of (*a*) a non-operative and a postoperative group with initially advanced or recurrent cancer in which serial biopsies were done, and (*b*) a group in

which mastectomy was performed following profound regression of extensive primary tumors and regional lymph node metastases originally judged inoperable. These studies were carried out at various intervals after institution of hormonal therapy in an attempt to follow the sequence of histologic alterations. On the basis of a small number of studies, there is reason to believe that the changes occurring with androgens or castration may be comparable to those seen with estrogen therapy. A control series of breast cancers submitted to radical mastectomy without other treatment was used for comparison. Although revision may be required as experience increases, an attempt has been made to construct a composite picture of the events that may occur in breast cancer and its stroma undergoing regressive changes with hormonal therapy.

Gross Observations: Primary Tumor: The initial clinical change in the tumor and the stroma was usually a softening, followed by varying degrees of shrinkage. On section, a translucent edematous softening was predominant in the early months of treatment. Later, the areas involved assumed an opaque, silky, white, fibrotic appearance. Overlapping of these phases was common. Areas of tumor varying in size and number were grossly visible within the newly developed fibrotic areas. In several cases, only a small residual focus of tumor could be recognized, and in others the initial lesion appeared to be encased and compressed by a dense fibrous tunic. Occasionally, epithelization of ulcerative lesions occurred without obvious reduction of the over-all mass, although, as a rule, the two changes occurred concurrently. Initially fungating lesions that had undergone regression were usually replaced by depressed flattened pliable scars.

Microscopic Alterations: One of the earliest changes evident microscopically was an edematous loosening and dissolution of the stroma surrounding clusters of cancer cells. As a sequence, cancer cells apparently separated from clusters were seen lying free in the widened interspaces and often exhibited degenerative changes in the cytoplasm and nucleus. Disintegration of the nucleus appeared to follow the cytoplasmic changes. Infiltration of plasma cells during this latter phase was a prominent feature. Later, in lesions undergoing the most profound regression, most of the cancer and plasma cells apparently disappeared, leaving a loose, tangled connective-tissue stroma. This stage corresponded with the translucent softening seen on gross examination. Following this, there was active fibroblastic production, with eventual appearance of dense sparsely cellular collagen bundles closely pressed together and obliterating the interspaces. A feature of this phase was proliferation of elastic fibers, especially surrounding the duct systems. Histologic sections through early healing ulcerations revealed very thin layers of proliferating epithelium overlying a bed usually consisting of inflammatory and tumor cells. Later, when healing was complete, there was a somewhat thicker layer of epithelium spread over dense fibrosis, in which the skin appendages were absent. Similar changes were noted following regressions of cutaneous manifestations of the disease.

Lymph Node Metastases: Various gross and microscopic examinations of involved lymph nodes revealed degrees of necrosis, fibrosis, and cystic degeneration.

Osseous Metastases: Osseous metastases, studied in a few cases before and after estrogen therapy, exhibited varying phases of degeneration of cancer cells, fibrosis, deposition of calcium, and new bone formation.

Pulmonary and Hepatic Metastases: It is difficult to evaluate the eventual changes seen in metastatic lesions of the lung and liver, since the cases studied came to autopsy only after reactivation of the disease. Nevertheless, in a few instances changes similar to those in the accessible lesions were observed.

Degree of Malignancy versus Response to Estrogen Therapy: Clinically slowly growing tumors respond more satisfactorily to estrogen therapy. Histologically, it was

difficult to correlate the grade of the tumor with the response, but the more differentiated tumors generally appeared more responsive.

Determination of the gross and histologic changes in the various lesions of breast cancer after hormonal therapy demands intensive utilization of all available technics, including histo- and cytochemical methods, to further our knowledge of the mechanisms involved.

IV. DOSAGE AND DURATION OF HORMONAL TREATMENT OF BREAST CANCER

The ideal dosage range and duration of hormonal treatment of advanced breast cancer have not been conclusively determined. Nevertheless, from a practical standpoint, considerable progress has been made in the establishment of dosage levels and plans of treatment that can be expected to produce satisfactory results in the majority of potentially responsive cases. It is not known whether significantly larger dosages will influence the more refractory lesions, or if the more susceptible lesions will yield as consistently to dose levels lower than those commonly employed.

Androgens: Androgens are usually administered intramuscularly as testosterone propionate in oil, or testosterone in suspension, 50 to 100 mg. three times weekly. A number of other androgenic preparations which have recently become available for trial appear to produce similar beneficial effects, although their relative effectiveness has not yet been determined.

Estrogens: The largest number of cases to date have been treated with diethylstilbestrol in oral dosages of 10 to 15 mg. daily. Several other synthetic and naturally derived estrogens administered orally or by injection and in essentially equivalent biologic dosages appear to be equally effective. Details regarding these latter preparations and suggested dosages are given elsewhere (30). Estrogens are frequently not well tolerated at the onset. Careful supervision of the patient, revision of the dosage, and persistence will usually permit resumption of the original plan of treatment in a relatively short time. Where one estrogenic preparation is incompatible, another may prove satisfactory. A very small percentage of patients cannot tolerate estrogens in any form or dosage, so that the therapy must be abandoned.

Duration of Therapy: The first effects of castration or hormonal therapy in responsive cases of breast cancer are usually observed within three months after the initiation of treatment. Thus, a trial for this period of time should be allowed before resorting to other methods if the lesions do not respond. The favorable effects of estrogen therapy on soft-tissue lesions may appear rapidly and in most instances the initial response is noted within two months; objective bone charges are usually observed later. Androgens usually produce more rapid subjective and objective responses than estrogens so far as osseous metastases are concerned. Soft-tissue responses to androgen therapy are less frequent and may occur later than with estrogen therapy. Hence, when the symptoms secondary to osseous metastases are acute and disabling and a prompt effect is desired, androgens are preferable. Under similar circumstances, castration in premenopausal women is usually more efficacious than androgens, and the effects occur earlier after ovariectomy than with irradiation.

Hormonal therapy should be discontinued at any time if there is evidence of progressive growth beyond that anticipated or if serious complications occur. If favorable responses are observed, two general plans of therapy have been utilized in our studies.

1. Interrupted or limited treatment. Treatment is maintained at a constant dosage level as long as regression is observed but is discontinued within a few months after the disease appears to become stationary. Following this, the lesion may remain inactive for a considerable period. The rationale of this approach is based on the assumption that the residual cells are at least partially refractory and can adapt themselves in an environment created by

longer periods of therapy to become nonresponsive. It is further assumed that renewed growth of the less well adapted cells may again be treated with expectation of another favorable response. This potentiality has been confirmed in some cases.

2. Continuous treatment. Under this regimen, treatment is continued indefinitely at the same dosage or at lower "maintenance" levels after the disease has ceased to regress but remains inactive. This plan rests on the premise that the more susceptible cells will be affected first and that a longer period of therapy is necessary to influence the more resistant cells. It is also predicated that reactivation may be delayed for a longer interval by partially checking the growth capacities of the more refractory cells even though they eventually escape this influence and may assume even greater activity than that possessed originally.

With either method there is eventual reactivation of the disease, and it has not yet been established whether one or the other is more efficacious for maximal postponement of the recrudescence.

Combined Therapy: Estrogens and androgens have been tried simultaneously, since some actions of these hormones are synergistic, particularly in promoting osteogenesis. Testosterone may be used with irradiation to hasten suppression of ovarian function, if ovariectomy is not feasible, when a prompt effect is desired. This may be accomplished by inhibition of pituitary gonadotropic activity, by inhibiting the action of ovarian hormones either in the circulation or at the tissue level, or by a combination of these effects. On the basis of present evidence, it is difficult to demonstrate that the various combinations are significantly more effective than the individual use of the hormones or castration in suitable subjects.

When either estrogens or androgens are no longer effective after an initially favorable response, further benefits may be obtained in some cases by reverting to the other type of hormone. Likewise, castration may be of value following androgen therapy in some premenopausal women, and either estrogens or androgens may prove efficacious after castration effects are no longer maintained. Of considerable interest is the observation that patients may occasionally enjoy a further respite if hormonal therapy is discontinued completely when reactivation occurs. These observations indicate that shifts in hormonal balance are important factors in altering the course of the disease at various stages. These various responses may possibly be explained by assuming that the persistent cancer cells have adapted themselves to become dependent upon the newly created environment and, in turn, may be damaged or destroyed if the milieu is again altered. It is anticipated that many of the points discussed in this section will be clarified in the near future, particularly since considerable effort is being expended in this direction both by individuals and through a nation-wide program sponsored by the Committee on Research of the American Medical Association (Subcommittee on Steroids and Cancer) (14).

V. SYSTEMIC EFFECTS AND COMPLICATIONS OF HORMONE THERAPY

Estrogens and androgens in the dosages commonly employed in the treatment of breast cancer produce systemic effects that are not necessarily related to the primary objective. These changes have recently been reported (16) and will be treated in greater detail in an early publication (31). Since a number of these effects are well recognized, they are mentioned here only as a matter of record. Certain complications, however, may be deleterious or distressing to the patient and merit careful consideration.

Systemic effects common to estrogens and androgens are nausea and vomiting, edema, and hypercalcemia. Nausea and vomiting occur more frequently with estrogen therapy. They are usually mild and transient but at times are of greater severity. A large majority of patients with these symptoms become tolerant to the medication in a few weeks, usually follow-

ing adjustment of the dose. In a small percentage the symptoms are intractable and treatment must be abandoned. Edema is a result of sodium retention and in older patients may lead to congestive heart failure. This may be prevented in many cases by a low-salt diet and saline or mercurial diuretics. The edema may also precipitate thrombophlebitis in patients with a poor peripheral circulation (31). The usual measures—elastic bandages or stockings and elevation of the part—may be of value in the prevention of this complication if the edema becomes unusually severe. Hypercalcemia occurs only in patients with osseous metastases, particularly those who are confined to bed. This should be suspected early in the presence of persistent severe nausea and vomiting and subsequent drowsiness, dryness, apathy, and atonicity. In the later stages, there is vascular collapse and the patient may lapse into a stupor. The milder stages may be alleviated by prompt cessation of the hormone and intravenous administration of fluids with glucose and/or saline. In severe states, in addition to the above measures, intravenous infusion of a 2.5 per cent solution of sodium citrate may be effective. It has been postulated that sodium citrate converts calcium ions into a soluble weakly ionized citrate complex (32).

Undesirable reactions arising solely from estrogens are uterine bleeding, during and particularly after withdrawal of therapy, and urinary disturbances. Bleeding usually abates with cessation of estrogen therapy and conservative management. It is seldom sufficiently severe to require operative intervention, but if it persists longer than a week after discontinuance of the hormone, carcinoma of the endometrium or cervix, or stimulation of fibromyomas must be strongly considered. Urinary frequency and incontinence, usually of the stress type, are not uncommon, particularly in elderly women. These symptoms almost invariably disappear when treatment is discontinued (31).

Side-effects specifically related to androgen therapy are hirsutism, acne, ruddy complexion, hoarseness, and increased libido, which is sometimes intolerable.

The potentiality of serious complications with intensive hormone therapy emphasizes the extreme caution that must be exercised during the entire treatment period. The possibilities mentioned, together with other distressing side-effects, have led to a search for related compounds that might be as favorably effective without producing undesirable reactions. Several compounds have recently been introduced which apparently produce fewer side-effects and complications, but although they may favorably affect breast cancer, their efficacy as compared to the more active biologic preparations has not been established.

VI. COMBINED SURGICAL AND HORMONAL TREATMENT OF ADVANCED BREAST CANCER

Observations in our clinics in the past few years suggest that some advanced primary breast cancers originally judged unsuitable for operative procedures may be rendered susceptible to palliative surgical attack when significant regressions occur after castration or hormonal therapy. The data indicate that the lesions will invariably undergo reactivation even after a profound and prolonged regression. Mastectomy in suitable cases during the quiescent phase appears to offer an opportunity for continued palliation (33).

VII. RELATION OF IRRADIATION TO HORMONAL THERAPY AND CASTRATION

Early experiments were designed by the author to investigate the possible effect of estrogens on the radiosensitivity of breast cancer. It was reasoned from existing experimental evidence that the growth of the tumor might be accelerated by estrogenic hormones with a corresponding increased radiosensitivity. It was further entertained that estrogens might also enhance radiosensitivity through an increase in the vascularity of the supporting stroma and thus of the tumor. Possible relationships between estrogenic and radiation therapy were suggested by the initial observations.

Fig. 7. M. C., age 71. A. Appearance of recurrent carcinoma one month after estrogen therapy. No apparent change in the lesion. B. Regression three weeks after roentgen irradiation (1,200 r) while on estrogen therapy. C. Six weeks after roentgen therapy.

The original premise, however, was modified by the later recognition that regressive changes and decreased vascularity might also occur in some lesions, particularly after prolonged estrogen therapy in selected patients (cf. above). Furthermore, it became apparent that changes subsequent to androgen therapy or castration should also be studied in relation to possible radiation effects. Thus, in recent years considerable emphasis has been placed on these aspects of the problem. The bulk of our studies have been confined primarily to observations of various combinations of estrogens and radiation on the primary tumor and its accessible soft-tissue recurrences or metastases. Studies relative to the effect of radiation therapy on soft-tissue lesions under the influence of androgens or castration and on osseous metastases subjected to either hormonal therapy or deprivation are sparse. Thus, the following statements, based on independent and combined observations of the author and his radiological colleagues, must be considered as preliminary and subject to revision as our experience in this direction becomes more comprehensive.

1. Preliminary or Concomitant Estrogen and Radiation Therapy: Evidence indicates that estrogens in the earlier phases of therapy may increase the radiosensitivity of breast cancer. Reactions, more intensive than those usually seen within a relatively low dosage range of radiation, may occur when the same amount of radiation is given in conjunction with estrogenic therapy. In other words, under some circumstances, estrogens appear to enhance the effect of radiation. This may be due in part to an increased vascularity as a result of estrogen therapy, which can sometimes be detected clinically. Degrees of regression commonly anticipated with a specified dosage of radiation to untreated breast cancer may be seen in some cases with significantly lower dosages when estrogens are employed as preliminary therapy (Fig. 7). In addition, partial regression of lesions after initial treatment with estrogens, regardless of other factors, may permit even more effective radiation therapy, made possible through the use of smaller portals. Similar responses may occur with simultaneous estrogen and radiation therapy, but the possible advantage of one procedure over the other is difficult to judge at present. It should be pointed out that these statements apply only to the earlier phases of estrogen therapy.

TABLE II: COMPARATIVE EFFECT OF ESTROGEN THERAPY BEFORE AND AFTER RADIATION OR SURGERY

	No. Cases	Regression Per Cent
Primary lesion (no previous treatment	85	51
Recurrent after surgery	52	46
Recurrent after radiation	32	22

2. Estrogen Therapy After Preliminary and Effective Irradiation: Estrogen therapy of recurrences within an area of previous and initially effective radiation is ordinarily not as efficacious as it is for similar untreated lesions (Fig. 8) (Table II). Recurrences immediately beyond the field of irradiation respond the same as any other untreated lesion. It appears that the degree of radiation fibrosis is an important

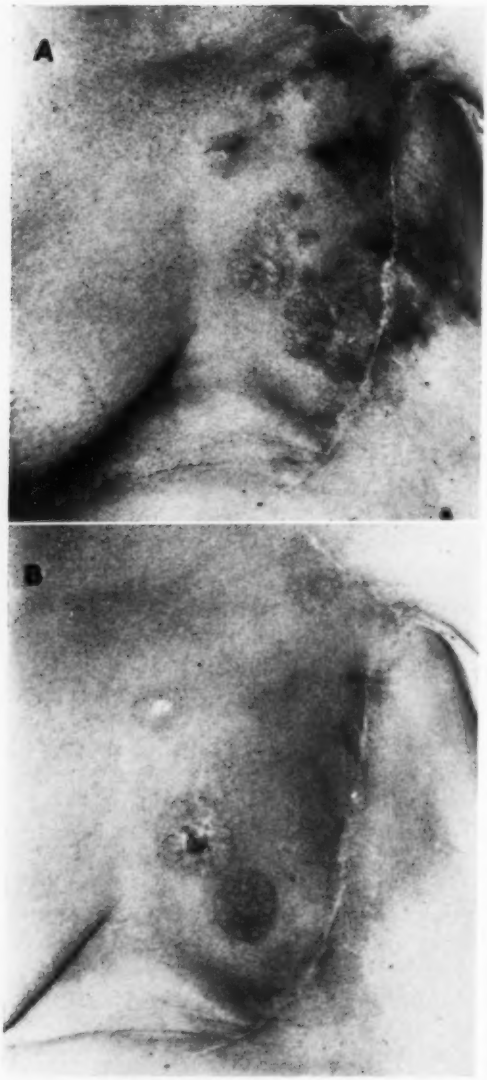

Fig. 8. L. G., age 62. A. Diffuse infiltration of operative field with recurrent carcinoma. Note previously irradiated areas. B. Regression of major disease after three months of estrogen therapy. Note persistence of recurrent nodules in previously irradiated areas.

factor by virtue of alteration of the vascular supply of the tumor.

3. Radiation Therapy After Prolonged Initial Regression with Estrogens: Late changes in the tumor bed following an excellent regression of the lesion with estrogen therapy are similar to those occurring after irradiation. Prominent features are fibrosis, collagen formation, and a decreased vascular supply that can often be detected clinically. Radiation therapy to areas of reactivation of the tumor in these sites must be applied with the same caution as if they had been previously irradiated. Non-necrotizing dosages of x-rays under these conditions have sometimes caused tissue damage and necrosis essentially the same as that attributable to excessive primary or repeated radiation therapy alone (Fig. 9). However, if the recurrence is beyond the original site of the tumor, radiation can usually be delivered in the usual dosage without producing severe or excessive damage. Similar effects might be anticipated following regressions of soft-tissue lesions after androgen therapy or castration. The late gross and histologic changes following such treatment do not appear to be significantly different than those seen with the estrogens.

4. Radiation Therapy of Osseous Metastases in Relation to Estrogens, Androgens, and Castration: Radiation therapy to localized osseous metastases from breast cancer may alleviate pain and promote calcification of osteolytic lesions. These same effects may occur with radiation therapy to lesions that initially respond to hormonal therapy and undergo reactivation or are primarily hormone-resistant. Contrariwise, hormonal therapy or castration may favorably influence osseous metastases that are resistant or recrudescent after preliminary radiation. A recent study suggests that radiation therapy to localized osseous metastases is more efficacious and produces a higher percentage of response than successful hormonal therapy (23). In principle, as cited above, we are in complete agreement, but it is believed that additional and long-term studies are needed before this aspect of the problem can be settled.

DISCUSSION

Alterations of the hormonal status of the individual by the procedures described may profoundly influence the course and character of advanced breast cancer. Such altera-

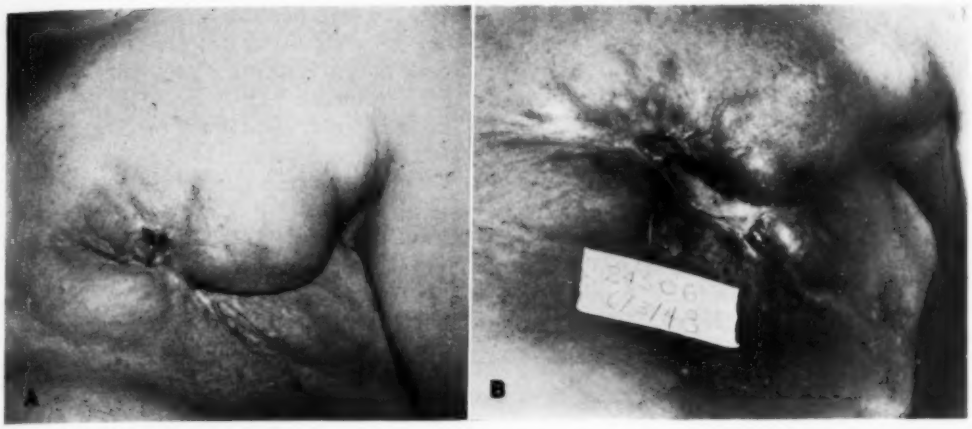

Fig. 9. A. S., age 64. A. Reactivation of cancer after excellent initial regression with estrogen therapy. B. Radionecrosis ten weeks after 2,400 r of roentgen irradiation.

tions probably occur spontaneously as well, and may account for the wide variations in the course of untreated breast cancer (34). The modes of action are subtle, as further indicated by the considerable variability in the responses of apparently identical lesions among comparable patients to a single form of therapy. Of further importance is the fact, that in different individuals estrogens, androgens, and castration are capable of producing essentially similar effects, although not to the same extent, on the various manifestations of breast cancer (Table III). Even

TABLE III: RELATIVE EFFECTS OF SEX HORMONES AND CASTRATION ON ADVANCED BREAST CANCER IN RELATION TO MENOPAUSAL STATUS (GRADED 0–3)

	Estrogens	Androgens	Castration
Menopausal status	Post-	Pre/Post-	Pre-
Primary lesion	3	1	1+
Soft-tissue metastases	3	1	2
Osseous metastases	3	3	3

though the precise mechanisms cannot be defined, observations suggest that the metabolic pathways and capacities of the hormones at any given time may be governed by genetic predispositions and the current physiologic status of the host. Certain possibilities, some of which appear to be paradoxical, that bear on these points are as follows:

(1) The benefits of castration may occur from estrogen deprivation or as a result of a relative increase in androgenic or other hormonal activity. Estrogens in moderate dosage, administered in the presence of active ovarian function, may sometimes accelerate the growth of breast cancer. On the other hand, we have rarely observed intensified growth of breast cancer in premenopausal women with very large dosages, which almost invariably produce amenorrhea. In fact, with these dose levels we have noted regression of the tumor in a few patients. It is not known whether the commonly employed dosages would have produced the same effects in these particular instances. These findings suggest, however, that inhibition of pituitary gonadotropic factors under the latter conditions may play a role. Estrogen therapy in women castrated premenopausally may produce regression of breast cancer similar to that seen in older women who have had a spontaneous menopause (18). This indicates, therefore, that suppression of ovarian function, either artificially or naturally, renders the lesions similarly susceptible to estrogenic hormones, possibly through a change in the metabolic state of the host.

(2) The administration of sufficient amounts of androgens to premenopausal women leads to clinical effects similar to

those seen after castration. The effects may in part again be attributed to inhibition of pituitary gonadotropic activity, thus leading to suppression of ovarian function (35). As suggested previously, if elimination of estrogenic activity is the sole factor, this may occur in the circulation or at the tissue level. However, the role of androgens in protein synthesis and osteogenesis must also be taken into consideration. Androgens are conducive to protein formation either by stimulation of anabolism or by inhibition of catabolic processes. This capacity is also probably related to bone formation (36). These latter factors in themselves may produce beneficial systemic effects without necessarily influencing the tumor. Moreover, these same capacities may account to a great extent for the objective responses in metastatic osseous lesions, whereby tumor growth may be handicapped by increased bone formation without an effect on the tumor. This thesis is supported by the wide discrepancy between the subjective and objective responses to androgen therapy. In fact, in some instances, the disease may be accelerated in spite of general systemic improvement. The administration of testosterone to postmenopausal or castrated women sometimes results in an increased urinary excretion of estrogens (35, 37). This suggests that, under some circumstances at least, androgens are involved in increased estrogen production, which may help to explain the favorable effects on soft-tissue breast lesions occasionally seen in postmenopausal women. Although other and equally important factors are undoubtedly involved, the known physiologic properties of the androgens appear to be actively contributing to the observed effects on breast cancer. Thus, the potentialities of the androgens are manifold.

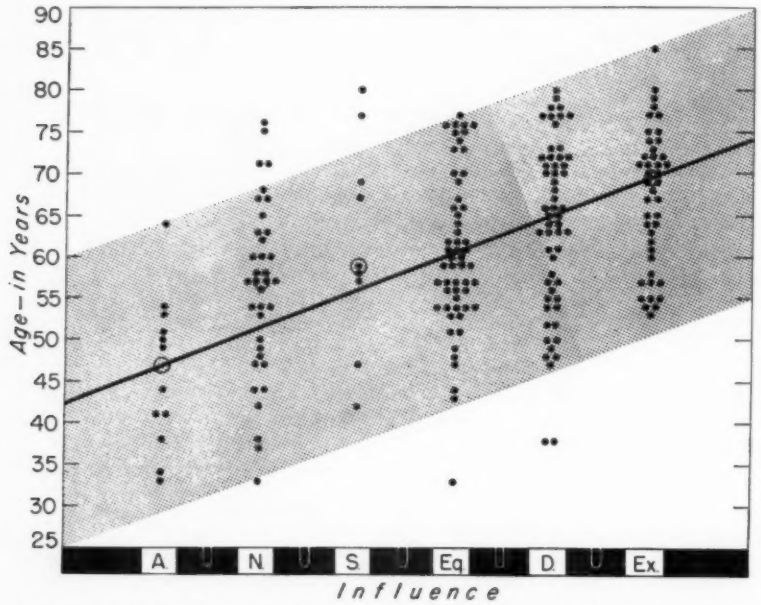

Fig. 10. Relation of estrogen effects to chronological age of patient. A. Acceleration. N. No effect. S. Stationary. Eq. Equivocal. D. Definite effect. Ex. Excellent.

(3) Estrogen effects on breast cancer appeared initially to be related to the chronologic age of the patient (Fig. 10). However, a critical study of the data suggests that the physiologic or metabolic age is important in governing the response. The functional activity of the ovary and probably other endocrine organs appears to

be an essential contributory factor. This thesis is supported by data obtained from an analysis of breast cancer response to estrogen therapy in relation to menopausal status, irrespective of the actual age of the patient, as shown in Figure 11. This chart includes patients of all ages but specifically relates to the time of the menopause, whether artificial or spontaneous. It appears that the chance of a favorable response of breast cancer to estrogens definitely increases five to ten years following cessation of ovarian function. Prior to that time, the effects are variable and, indeed, acceleration of breast cancer may occur in premenopausal women. This implies that the functional activity of the ovary may govern endocrinologic and metabolic interrelationships in the host and that the effect of exogenous estrogens is dependent upon these factors.

Theoretically, it can be postulated that under various circumstances, estrogens, androgens, and castration temporarily restore a substrate that is hostile to the development and growth of breast cancer. There are defects in this thesis, but the possibilities cannot be denied. It is disturbing that breast cancers showing profound regression after initially successful hormonal therapy or castration invariably undergo reactivation and at times appear to grow more rapidly than originally. It is equally challenging that a second favorable reaction of the tumor may occur when the initial therapy is abandoned, without further attempts at treatment or when other hormone therapy is instituted. This suggests that lesions behaving in this fashion are vulnerable to induced changes either at the cellular or environmental level. Absence of response under these same circumstances, as in the case of initially unresponsive tumors, implies development of complete autonomy of the remaining cells or a failure of mechanisms which may favorably influence the cell or its soil.

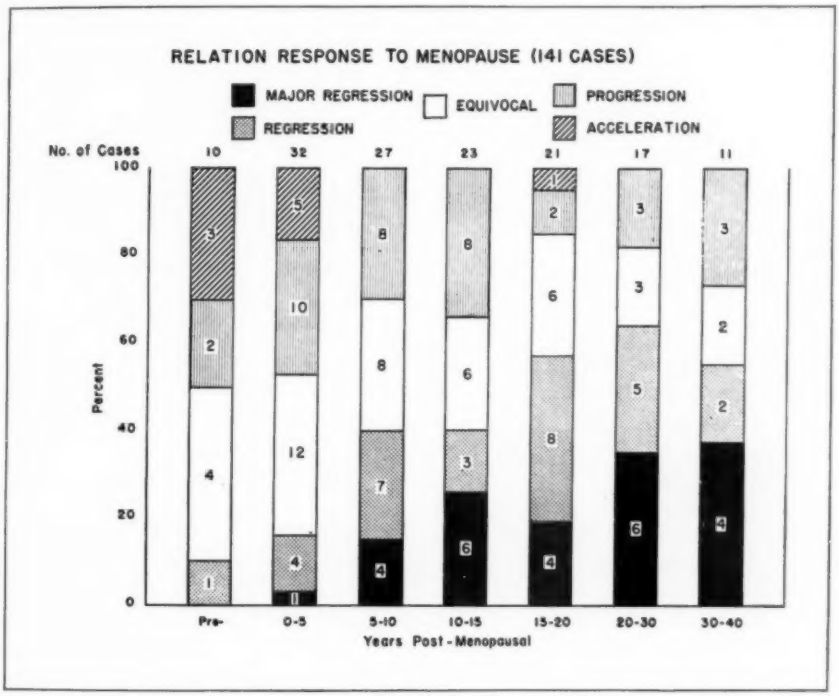

Figure 11.

These are only a few of the myriad ques-

tions that need to be answered before a satisfactory solution of this problem can be reached. Encouraging is the concerted approach to the problem through the many facets suggested to the searching and imaginative mind by the realization that a tumor may be diverted from its intended course by spontaneous or induced alterations of essentially physiologic processes.

CONCLUSIONS

1. The natural behavior of untreated breast cancer must be understood for an evaluation of hormonal treatment, as in the case of other therapeutic procedures.

2. Established surgical and radiation technics, wherever feasible, should be used as a primary method for probable curative or palliative control of breast cancer.

3. The indications and effects of hormonal treatment in advanced breast cancer are becoming better defined.

4. There is now indisputable evidence that the course and character of some breast cancers may be retarded or accelerated by the administration or deprivation of sex hormones.

5. There is no evidence that sex hormones or castration will result in permanent control of even the most susceptible breast cancers, for the effects are temporary and usually of short duration.

6. Hormonal therapy can be considered as another weapon in the treatment of breast cancer and is of greatest value when the disease is beyond the realm of possible benefit from established procedures.

7. Hormonal therapy under proper conditions may be used to advantage as an adjunct to surgical and radiation therapy of breast cancer. This suggests that the relative roles of surgery, radiation, and hormones should be the subject of further investigation in the effective control of breast cancer.

8. Caution must be exercised when sex hormones are employed in the treatment of breast cancer because of possible serious complications. These risks can be minimized if proper precautions are taken and are justified in suitable cases when the ultimate aim is considered.

9. The effects of hormones on breast cancer seriously challenge the long-held theory of autonomy of the cancer cell. The observations indicate that some cells judged neoplastic by classic definitions are apparently susceptible to direct attack or through changes in their environment by agents that are essentially physiologic in action.

10. Careful and continued observations of the effects of hormones on susceptible tumors should lead to increased understanding of the mechanisms in growth processes. A new tool for the study of cancer has been provided. Information from this approach should add materially to our knowledge of etiologic aspects and in turn may lead to our ultimate objective of more effective therapy.

Massachusetts General Hospital
Boston 14, Mass.

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SUMARIO

Las Hormonas del Sexo y la Castración en el Cáncer Mamario Avanzado

Si bien la cirugía y la irradiación continúan siendo los métodos óptimos para el tratamiento curativo o paliativo de las manifestaciones localizadas del cáncer de la mama, cada vez se van poniendo más de manifiesto y definiendo mejor las potencialidades de la hormonoterapia. Cabe utilizar la misma como: (1) providencia inicial para lesiones primarias seleccionadas más allá del alcance de un efectivo ataque quirúrgico o radiológico; (2) coadyuvante de la cirugía o la irradiación, en particular cuando las manifestaciones se hallan diseminadas y el tratamiento local no resulta factible; o (3) procedimiento secundario para las lesiones tratadas primitivamente en pleno con la cirugía o la irradiación pero ya incoercibles con uno u otro método.

La castración, bien con la cirugía (ovariectomía) o con la irradiación, da sus mejores resultados en las mujeres que no han alcanzado aun la menopausia. Resulta primordialmente de valor como medida paliativa y sus efectos beneficiosos muestran una duración limitada. En el varón, la emasculación parece ser más eficaz

en los enfermos de alguna edad, y para la misma, la orquiectomía es sin duda más efectiva que la irradiación.

Los andrógenos pueden ser utilizados como paliativos del cáncer mamario avanzado en las mujeres a toda edad. La efectividad de los mismos parece depender de la edad de la enferma y del sitio de la lesión. Su acción más eficaz parece radicar en las metástasis óseas y en los síntomas producidos por las mismas.

Los estrógenos pueden afectar favorablemente todas las manifestaciones postmenopáusicas del cáncer mamario en la mujer. Sus efectos más manifiestos recaen sobre las lesiones de los tejidos blandos, en los que la respuesta es mayor que a los andrógenos. En las mujeres que no han alcanzado aun la menopausia, puede sobrevenir aceleración del desarrollo del tumor a continuación de la estrogenoterapia.

No hay pruebas de que las hormonas del sexo o la castración logren cohibir permanentemente ni aun las lesiones más susceptibles, pues los efectos son pasajeros y por lo general breves.

Hay que desplegar cautela al emplear hormonas del sexo en el tratamiento del cáncer mamario debido a la posibilidad de complicaciones. Los efectos orgánicos comprenden náuseas y vómitos, edema, y, en los enfermos con metástasis óseas, hipercalcemia. Los estrógenos pueden provocar metrorragia y trastornos urinarios. Los efectos subsidiarios enlazados específicamente con los andrógenos son hirsutismo, acné, ronquera y excitación del libido. Los riesgos descritos pueden ser reducidos a un mínimo tomando las precauciones procedentes y pueden estar justificados a la luz de la meta definitiva.

Los efectos de las hormonas sobre el cáncer mamario ponen en tela de juicio la vieja teoría de la autonomía de la célula cancerosa. Las observaciones realizadas indican que algunas células son susceptibles al ataque directo o por medio de alteraciones introducidas en su ambiente por agentes cuya acción es esencialmente fisiológica. La continua observación de los efectos de las hormonas sobre los tumores susceptibles debe conducir a una comprensión mejor de los mecanismos del desarrollo y, por aumentar nuestros conocimientos de la etiología del cáncer, llevarnos a una terapéutica más eficaz.

DISCUSSION

Henry J. Ullmann, M.D. (Santa Barbara, Calif.): I should like to ask Dr. Nathanson three questions. First, I am not clear about the use of estrogen after androgen. If one has been used and you want to switch to the other, what is the outcome? Second: Were the results reported obtained with estrogen or estradiol, or an equivalent? Finally: Is there just as much danger, or nearly as much, in giving estrogens after irradiation as before?

Dr. Nathanson: We have conducted this study on an experimental basis and have attempted to free ourselves of as many variables as possible. However, our data indicate that in some instances patients initially successfully treated with estrogens may obtain a further response if androgens are used when there is reactivation of the disease. The same may be said of the reverse procedure, but many more observations are necessary before a definitive answer may be given on these points. Combined estrogen and androgen therapy on the basis of our present data does not yield better results than those observed with either hormone alone in properly selected cases.

As far as the estrogens are concerned, we have screened 10 biologically variable compounds belonging to four chemical groups to see if there was a difference between the chemical configuration and the biological effect or if there was some common denominator in the response of the breast lesions. All we can say, at present, is that any compound which produces an effect on breast cancer is also biologically active as far as estrogenic activity in the true sense is concerned. We are not able to say that one estrogen is better than another.

In answer to the third question, we have seen no deleterious effects in previously irradiated areas when estrogen therapy has been subsequently instituted.

Dr. Ullmann: Do you give very large doses?

Dr. Nathanson: We give moderately large dosages. I do not know the optimum dosage of either class of hormone. However, the doses used apparently are adequate for evaluation of the relative effects on breast cancer. It is anticipated that, through mass studies, optimum dosage levels will be determined.

Radioactive Cobalt^{60} in Plastic Tubing for Interstitial Radiation Therapy[1]

JOSEPH L. MORTON, M.D., GEORGE W. CALLENDINE, JR., M.S., and WM. G. MYERS, Ph.D., M.D.

Departments of Radiology and Medicine, Ohio State University Medical Center
Columbus, Ohio

WHENEVER A SUITABLE new source of ionizing radiation becomes available, the radiotherapist is challenged or exercise his ingenuity to adapt old technics or invent new ones to exploit fully any physical advantages of the new source over the conventional ones already in use. During the past three years studies have been under way to develop methods by which radioactive cobalt^{60} may be used interstitially to supplant radium in this form of therapy (1, 2, 3). Some advantages of cobalt^{60} over radium for this purpose are as follows:

(1) The beta radiation is much softer, 0.31 mev (max.) and is easily filtered out. (2) The gamma radiation is homogeneous, 1.16 and 1.31 mev. (3) There is no leakage—no gaseous radioactive daughters. (4) The dangers of breakage are eliminated. (5) Suitable alloys of cobalt are chemically inert. (6) It will not localize in bone; cobalt ions are quickly eliminated. (7) It is magnetic, which makes handling easier and safer. (8) The strength is calculable before irradiation in the pile. (9) Residual activity can be "warmed up" in a nuclear reactor. (10) Suitable alloys containing cobalt are inexpensive. (11) Cobalt^{60} can be generated in any desired quantity. (12) It is available at moderate cost.

A report of preliminary studies with Co^{60} applied in interstitial therapy in the form of needles fashioned from stainless steel or monel tubing in which the radioactive sources had been placed has been presented previously (2). It soon became apparent during these investigations that clinical situations are frequently encountered in which rigid needles cannot be implanted satisfactorily. Many of the clinical problems which arose suggested the need for a flexible "linear" source which could be made to follow the contours of tumor infiltration. It was thought that this type of applicator would not only facilitate a more desirable implantation pattern, with a consequent increase in the efficacy of treatment, but that it would also add to the comfort of the patient during the irradiation. It is the purpose of this report to describe methods of preparation and handling of flexible plastic tubing containing Co^{60} and to summarize experiences with its use in interstitial therapy, to this time, at the Ohio State University Medical Center.

SOURCES

Cobalt wire cut to form cylinders[2] 0.508 mm. in diameter by 3.0 mm. long was irradiated in the nuclear reactor at Oak Ridge sufficiently long that the initial gamma ray intensity of each cylinder was equivalent to that of about one-third of a millicurie of radium. End-to-end apposition without spacing then gave a linear intensity equivalent initially to approximately one millicurie of radium per linear centimeter. Lesser linear intensities are readily obtainable by placing aluminum spacers, cut to appropriate lengths from 24 gauge wire, between the active cobalt cylinders. Attempts were made to use even smaller diameters of cobalt, but these were found to be impractical.

Nylon tubing[3] 0.76 mm. inside diameter

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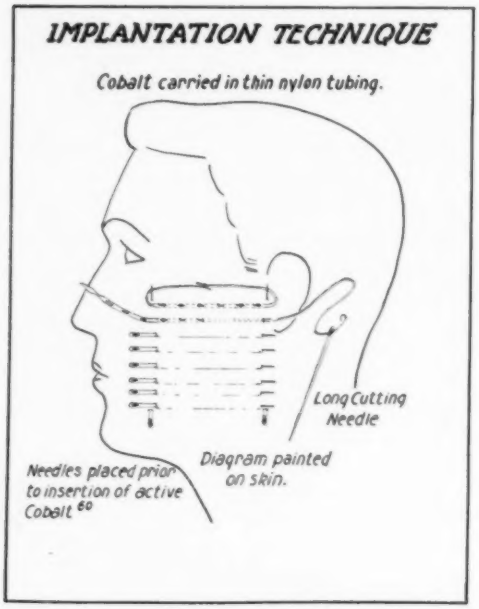
[1] This investigation, conducted at the Ohio State University Medical Center, was assisted by a joint program of the Office of Naval Research and the Division of Biology and Medicine of the United States Atomic Energy Commission through a contract with the Ohio State University Research Foundation. Presented at the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950.

[2] Purchased from the Callite Tungsten Corporation, Union City, New Jersey.

[3] Furnished by the Elmer P. Mills Co., 2930 North Ashland Avenue, Chicago 13, Ill.


IMPLANTATION TECHNIQUE
Cobalt carried in thin nylon tubing.
Long Cutting Needle
Diagram painted on skin.
Needles placed prior to insertion of active Cobalt 60

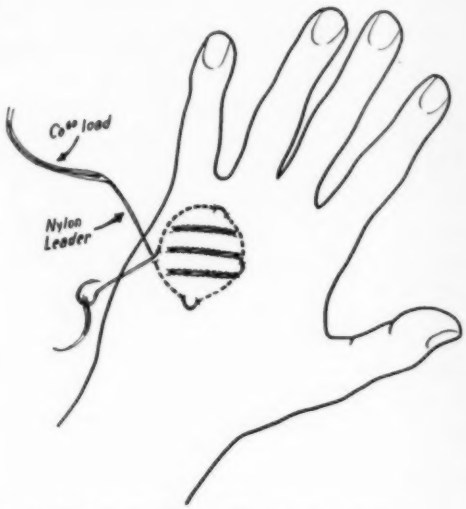


Fig. 1. A (left). Nylon threads drawn into previously planned pattern with straight surgical needles. B (right). Curved needle employed for circular pattern.

and 1.27 mm. outside diameter (0.25 mm. wall) was found to have suitable properties for the purposes at hand. The inside diameter is sufficiently greater than the diameter of the cobalt cylinders that they can slide freely within it without bunching together. The outside diameter was chosen to provide a wall thickness which filters out more than 93 per cent of the beta particles emitted through the surfaces of the radioactive cobalt cylinders. In histologic evaluations of the periacicular necrosis of animal tissues after irradiation, it was found that the effect of the remaining beta particles which penetrate the nylon tubing cannot be distinguished from the tissue injury resulting from the trauma of implantation.

Nylon tubing was chosen as the most practical vehicle after experimentation with several flexible plastic materials. It can be sterilized by heat or chemically; it is flexible enough to yield to the body motion of implanted parts and yet is sufficiently stiff to facilitate insertion; it has high tensile strength at body temperature; and, after gentle warming, it exhibits a sharp but limited reduction in diameter when drawn or stretched, making possible its insertion as a suture, with a surgical needle.

LOADING

Before loading the nylon tubing with the radioactive cobalt cylinders, it is constricted a few inches from one end by warming it a few seconds at that point against a light bulb and then drawing it to decrease the diameter sufficiently to prevent passage of the cylinders through the lumen. Cylinders of the desired strengths, interspersed with aluminum spacers of correct length, if any, are loaded into the other end of the tube and slid against the constriction. The other end of the tubing is sealed behind the load with a moderately warm electric soldering iron, the temperature of which is regulated with a rheostat. An appropriate length of the tubing is left beyond this seal to permit stretching in the operating room. The lengths of the aluminum spacers are varied appropriately to provide the desired linear intensities of sources as determined by the volume to be irradiated, the optimum time of treatment,

the position of the threads in the implant, the inability to "cross ends," and other considerations.

STERILIZATION AND DRAWING INTO THREADS

Sterilization is done either chemically or by boiling. When the radioactive tubes are boiled, the ends which extend beyond the loaded central portions are readily drawn while still warm. The tubing is thereby extended in length approximately threefold by pulling lengthwise between two hemostats. A definite limit is felt by the operator beyond which further stretching will not occur. This is a point of maximum strength for the drawn nylon tubing and is thought to be associated with molecular alignment or orientation.[4] The drawn inactive ends of the nylon, about 12 to 18 inches long, constitute strong threads of sufficiently small diameter to be threaded readily onto ordinary surgical needles (Fig. 1).

IMPLANTATION

The loaded nylon threads may be implanted into any site to be irradiated which can be reached by long, straight or curved needles or by straight or grooved pointed guides used like aneurysm needles (Fig. 2). Some pressure deformation of the area by the needle is of no consequence, as the thread will flex sufficiently when it is pulled into position to adapt itself to the curvature of the part. It is often convenient to tie a dressing in place over the implant with the ends of the threads. Care is necessary in doing this lest the planes of the implant become curved upward at the margins, resulting in an irradiation pattern which is different from the one originally planned.

In cases in which the pattern is complex, it is advisable to insert the guide needles by hand or with instruments and to complete the entire pattern with the surgical needles in position before threading the nylon onto them. The radioactive threads are then quickly drawn into position and the exposure to the hands of the operator is minimized.

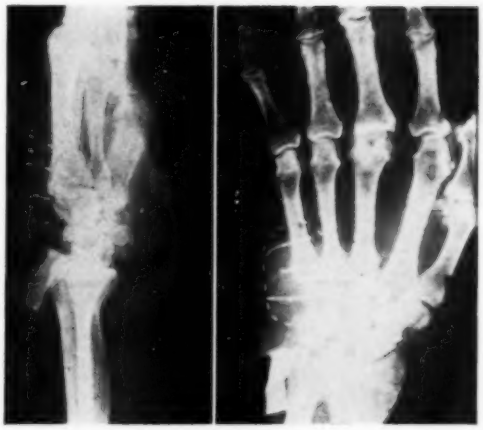


Fig. 2. Radiograph of dorsum of hand with implantation of nylon threads as shown in Fig. 1B. Elderly patient required no hospitalization and shows good regression, with normal skin to date.

Two types of guide needles are being used successfully:

(1) The large surgical needle. This may be curved or straight, cutting or round-pointed, depending upon the requirements of the particular application. Keith needles 3 and 4 inches long are standard equipment on the tray. The diameter must be large enough that undue traction is not required to position the thread.

(2) Grooved guides with an eye at the cutting point (Fig. 3). These are made from 13-gauge Luer-Lok needles 10 cm. long. One-third to two-thirds of the side opposite the point is ground or filed off the tubular needle to make a grooved guide, or director. An eye is made by drilling a hole a short distance from the point. A metal rod is machined to fit the Luer-Lok adapter at the other end and can be attached to the guide to facilitate handling. During insertion, these guides are sufficiently flexible to be bent gently toward the lumen when the operator wishes to thread around irregular curves, to avoid blood vessels, etc. After the guide is inserted, the stretched end of a loaded nylon tube is threaded through the eye and

[4] Personal communication. J. M. Gladden, Nylon Division, E. I. du Pont de Nemours & Co., Wilmington, Del., Oct. 19, 1950.

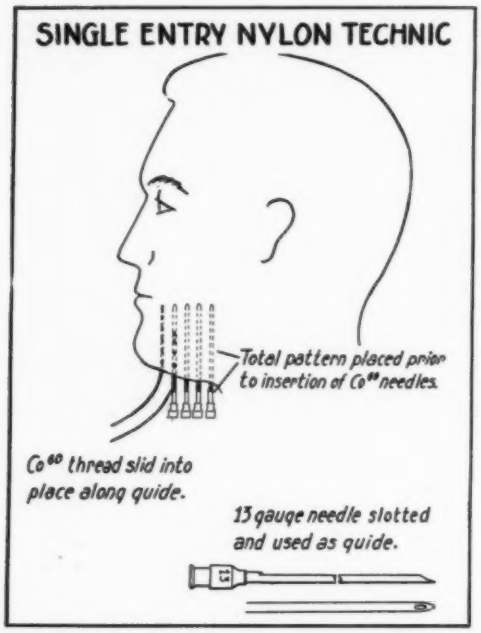

SINGLE ENTRY NYLON TECHNIC
Total pattern placed prior to insertion of Co⁶⁰ needles.
Co⁶⁰ thread slid into place along guide.
13 gauge needle slotted and used as guide.

Fig. 3. Grooved guides made by grinding off one side of a 13-gauge needle find many uses. If puncture of a major vessel occurs, it is made known by bleeding along the groove and the guide is withdrawn and reinserted at a slightly different angle. These guides can be curved as desired and the point brought through the surface to be threaded in the depths of a wound. The groove guides the nylon end through the eye, making threading much easier than with the standard needle.

the active section is drawn into position as the guide is withdrawn.

Where an exit point for the directors is not practical (lateral nasopharyngeal wall, etc.), one drawn end of the nylon is cut off and the thread is inserted along the groove of the guide. A silk suture at the skin surface maintains the position of the thread.

If a vessel be punctured by the guide, the cut is a linear one similar to that produced by some types of spinal puncture needle, and the accident is revealed immediately by the flow of blood. This is an advantage over the solid surgical needles, which usually occlude a punctured vessel so that the accident is often not recognized until removal of the implanted tubes.

When an implantation is planned, the problem may arise as to the practicability of crossing the ends of the pattern, whether of the planar or the volume type (4). When Co^{60} loaded into the nylon threads is available, sufficiently high dosages at the ends to solve the problem may be realized in any one, or in combinations, of four different ways: The ends of the threads may be crossed; the ends of the threads may be tied together so that the radioactive cylinders are deflected toward one another at the ends; the ends of the active portions of the threads may be loaded with shorter aluminum spacers, or without any spacers; or the ends may be loaded differentially by using radioactive cylinders of variable strengths as a result of different intervals of exposure in the nuclear reactor or various times of decay after irradiation.

REMOVAL FROM THE PATIENT

Most of the implantations are planned so that the irradiation continues for at least a week. At the end of that time the radioactive threads are not adherent. A drawn, thin section at one end is cut and the thread is removed without difficulty by gentle traction on the opposite end, analogous to the removal of a stay suture. No anesthetic is required, and the patient experiences little, if any, pain.

REMOVAL OF THE RADIOACTIVE COBALT FROM THE NYLON THREAD

The cobalt cylinders are recovered from the nylon threads after removal from the patient by immersing them in cresol for a few hours at room temperature to dissolve away the nylon (4). The cylinders in the bottom of the beaker are removed with the aid of a small electromagnet (1), washed with water to remove the cresol, and stored, ready for use again. Alternatively, the tubing may be cut squarely across with a sharp surgical knife and the cylinders then either shaken out or removed by aspiration. The chemical method is preferable from the standpoint of radiation safety as well as labor economy.

CLINICAL CONSIDERATIONS

Advantages accrue from the fabrication of the radioactive nylon threads to meet a

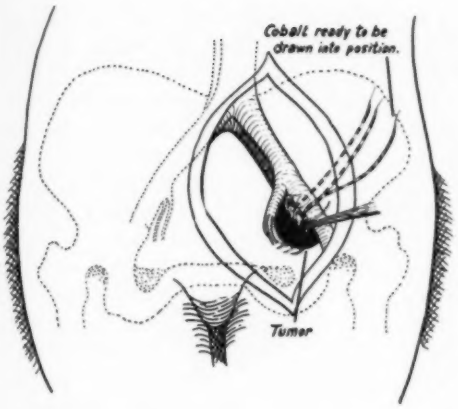


Fig. 4A. Diagram of method of implantation of nodes in the retroperitoneal area. Both ends of the nylon are usually brought through the operative incision. This technic has been employed three times in nodes, four times in the bladder.

specific radiotherapeutic problem as it arises. When each case is considered individually, the radiologist and the physicist plan together the best possible pattern of irradiation. There is less tendency to stereotype or to compromise because of the limitations imposed by fixed sources which might happen to be available at the moment, as is too often the case when only radium sources are on hand.

The larger the implantation, the more critical is the need for an accurate uniform irradiation to all the tumor. Large implantations cannot easily be made correctly with rule-of-thumb calculations in the operating room. They require careful planning, even though this necessitates an additional anesthetic and surgical exposure. Despite attempts to preplan all implants, it has been found advantageous to keep sufficient threads loaded appropriately to construct a 4 × 4-cm. or 6 × 6-cm. planar implant or both. Then, when the surgeon either finds he cannot resect all of a tumor, or discovers a tumor unexpectedly when operating with another diagnosis, these sources are available.

A potentially useful but incompletely explored application of the radioactive nylon threads is the implantation of retroperitoneal lymph nodes before closure of a

Fig. 4B. Radiograph of Co^{60} implanted into presacral nodes.

laparotomy. With a curved needle, the active section of one or more of the threads is imbedded in the node or its base and the free ends are brought out through the incision during closure (Figs. 4 and 5). These ends are held by a hemostat incorporated in the dressing during the week or so of irradiation. A gentle tug brings the sources out through the abdominal wall without further surgery and with little discomfort to the patient. Similar implantations have been made in the bases of tumors of the bladder and of the urethra which were exposed at laparotomy. Although insufficient time has elapsed to accumulate an extensive experience with this method of implantation, it appears desirable to combine it with surgical excision of cancer when there is doubt that all of the tumor has been removed.

The radioactive sources encased in flexible plastic or readily applicable to the implantation of the cheek, lip, tongue, and

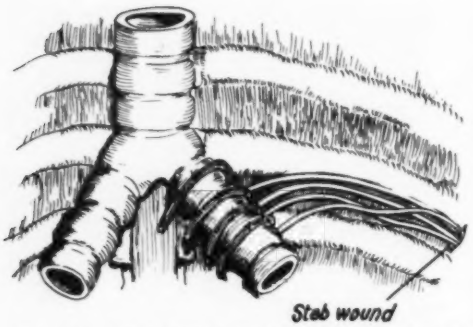


Fig. 5A. Intrathoracic technic for irradiating left main bronchus after removal of carcinoma of the esophagus adherent to bronchus. The nylon passes extrapleurally (not shown).

submandibular areas. They are used exclusively at present for the transfixion of cervical nodes. They are useful surgical adjuncts in areas where soft tissues cannot be sacrificed without loss of function, as in the pterygoid fossa, where the soft palate takes muscular attachment. Excision of this region would destroy the function of deglutition. The threads may be easily implanted about the ascending ramus of the mandible. When laryngectomy and pharyngotomy fail to remove all of a tumor in the base of the tongue, circular ties are made through the suture line to discourage regrowth. The suture line can be strengthened by planning the implantation so that the radioactive threads also function as stay sutures. Patients can eat with little discomfort due to the radioactive nylon threads.

Plaques are easily constructed by loading the Co^{60} cylinders into nylon tubes and flexing them in the desired shape during attachment to the mold or template.

A continuous circular implantation can be made in the skin by attaching a nylon thread to a curved needle of a length one and a half to two times the radius of the curve. Such a needle can be brought to the skin surface and reimplanted through the same puncture. When the diameter of the circle exceeds 4 cm., the nylon tubing slips around without locking.

The flexibility of the radioactive nylon threads makes it possible to transfix a node which is not too large, bracketing it with the two limbs of a "U" of radioactive material. This method of implantation has proved useful in nodes along the bony walls of the pelvis. When the implantation is near the great vessels, there is a lesser likelihood of erosion than with metal needles. The flexibility of the nylon lessens the transmission of the pressure of overlying soft tissues, and there are no sharp points present.

The advantages of the radioactive nylon threads for implantations adjacent to bone are self-evident. The energies of the

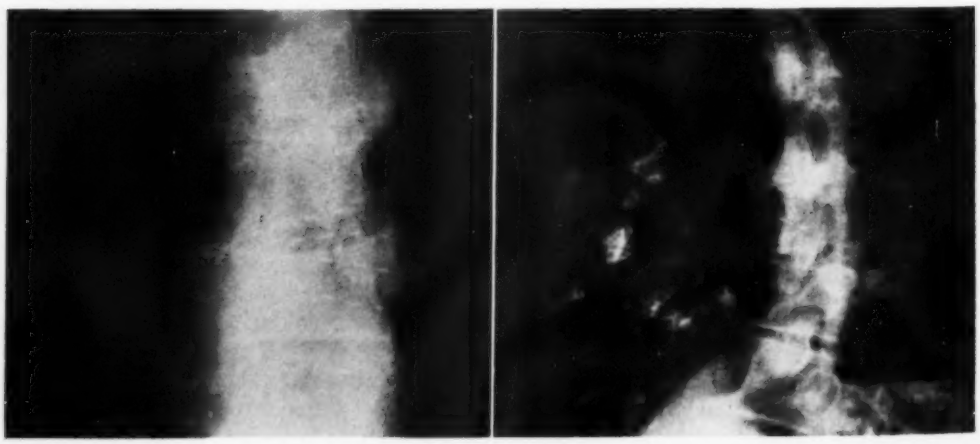


Fig. 5B. Radiograph of Co^{60} implanted and sewn to the adventitia of the bronchus. These approaches are experimental but show promise.

gamma photons emitted by Co^{60} are sufficiently great that the differential overdosage of bone is largely avoided (5) in contrast with the undesirably high bone-time absorption rates of 200- to 400-kv. x-rays, as well as the beta and softer gamma components emitted by insufficiently shielded radium or radon.

SUMMARY

1. The preparation of flexible plastic threads containing small cylinders of radioactive cobalt^{60} is described. The walls are sufficiently thick to filter out all but insignificant amounts of the beta particles emitted by the radioisotope. The threads flex readily into circular patterns and implantations of irregular shape.

2. This technic makes it possible for the therapist to sew sources of gamma radiation averaging 1.2 mev into any treatment site that can be reached by a needle, either directed from surfaces of the body or during surgical procedures. Upon completion of treatment, the radioactive threads are removed like sutures.

3. Because of the flexibility of the radioactive nylon threads, patients are more comfortable following implantation than they would be with rigid needles.

4. Use of these new sources enables the therapist to achieve a more uniform and effective pattern of radiation in many areas than would otherwise be possible. Typical examples of advantageous clinical applications of radiation by this means are described.

College of Medicine
The Ohio State University
Columbus 10, Ohio

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SUMARIO

El Cobalto Radioactivo^{60} en Tubos Plásticos para la Radioterapia Intersticial

El método de irradiación intersticial descrito utiliza pequeños cilindros de cobalto radioactivo (Co^{60}), introducidos en tubos flexibles de nilón, que pueden atornillarse en largas agujas quirúrgicas, ya rectas o curvas, o en fiadores puntiagudos acanalados utilizados como agujas para aneurismas, para introducción en el sitio del tratamiento. Las paredes de los tubos de nilón son suficientemente gruesas para excluir todas las partículas beta, aparte de fracciones insignificantes, emitidas por el isotopo. Las hebras son flexibles y se prestan en particular para patrones circulares de irradiación y para implantes de forma irregular. Al terminar el tratamiento, se extraen sin dificultad como si fueran suturas.

Esta técnica permite "coser" focos de rayos gamma que promedian 1.2 millones de electrón-voltios en cualquier sitio de tratamiento al que pueda llegar una aguja, ya desde la superficie del cuerpo o durante algún procedimiento quirúrgico. Cabe obtener así en muchas zonas un patrón más uniforme y efectivo de radiación que el obtenible de otro modo, y el paciente experimenta menos molestia que con los implantes rígidos.

Descríbense típicos ejemplos de provechosa aplicación clínica de la irradiación con esta técnica.

DISCUSSION

Isadore Meschan, M.D. (Little Rock, Ark.): I would like to congratulate Dr. Morton for his beautiful presentation of his application of cobalt[60]. At the University of Arkansas, we have been interested in cobalt[60] for the past three years and have been experimenting along slightly different lines. We have been encouraged to present, very humbly, our preliminary results in a comparison of the radiation from radium and the radiation from cobalt[60]. I say "humbly" because, frankly, it has us worried. It is contrary to what we would have expected.

With Dr. Stone's words still ringing in our ears, regarding care in the use of any new form of radiation, we felt under obligation to test this new form of radiation biologically before utilizing it on patients.

In our initial experiments we wanted to see what the needles which we had constructed would do in comparison with the radium needles with which we were familiar. We constructed our needles very simply, using ordinary hypodermic steel and hypodermic tubing, and placing our cobalt wire directly in this hyperchrome steel as shown in our exhibit. Rabbits were used as experimental animals, the right side of the abdomen being implanted with radium and the left side with cobalt[60].

In utilizing radium and cobalt needles in two identical areas in the same rabbit, 6 cm. apart, trying to control all the factors as well as we could—and there are always a few small variable factors in interstitial experiments that are uncontrollable—we found that there was a disturbing difference, slight but fairly definite, in the reactions observed in the skin on the two sides of the abdomen.

We did both gross and microscopic studies in 43 rabbits. Our microscopic material was taken from these identical areas at intervals of one, two, three, and four weeks. Our gross observations were carried out over periods up to six months in the case of each rabbit.

We found that in about one-third of our rabbits—speaking collectively for both the 4,000 gamma roentgen and 7,000 gamma roentgen series—the reactions were identical, but in two-thirds they appeared slightly different on the two sides, different enough to give us some concern. Contrary to what we would have expected, the reaction on the cobalt side was slightly greater. We have pursued this from the standpoint of a possible difference in the secondary beta rays coming from the needle, and we are now pursuing it from another standpoint, namely plaque application. We repeated the experiment on four persons with plaque application and obtained similar results with 3,000 gamma roentgens. Our densitometer (photometric) experiments, however, showed the two plaques to be identical.

I merely want to inject this note of caution because there is an increasing number of requests for the use of cobalt[60]. Very likely these differences may not be perceptible clinically. I do feel, however, that in the use of any new form of radiation the problem must be approached in an effort to try to test the biological effects regardless of how similar we think the physical effects.

And speaking of physical effects, they really are not identical. Radium has a spectrum that is very difficult to average. It is impossible for the physicists to give us an average energy radiation for radium. They say somewhere around 0.8 mev. The two gamma rays from cobalt are 1.1 and 1.3 mev. That may not be enough to cause us to think of it as a different type of radiation; nevertheless, a note of caution seems justified.

Incidentally, I want to express our extreme gratitude, as I have in the past, to Dr. Friedell of Western Reserve University, who has encouraged us in our work along these lines.

Dr. Morton (*closing*): I want to point out that our two needle technics, Dr. Meschan's and mine, are somewhat different. I don't know why he gets hot spots in his margins, as he suggests. That would require going into the exact technic and duplicating it. It remains that our reactions come up nicely; They are what we would anticipate from an energy of this sort, and we think we are curing disease with this method.

Air-Contrast Colon Examination with Colloidal Barium[1]

HENRY H. JONES, M.D., HENRY S. KAPLAN, M.D., and FRANK WINDHOLZ, M.D.[2]

San Francisco, Calif.

THE POSSIBILITY of visualizing pathological lesions of the colon by means of roentgen examination has intrigued physicians since the discovery of x-rays. Some of the pioneer workers used air or various gases as contrast material, while others employed suspensions of heavy metals or their salts. Priority in this field is difficult to determine, for even a brief perusal of the literature reveals that many methods were tried and discarded without benefit of publication.

Apparently the first person to place examination of the colon by the opaque enema on a firm basis was Haenisch (5) in 1911. Fischer (3) in 1923 was the first to establish the value of the double-contrast enema. Cole (2), Berg (1), and others studied the appearance of the mucosa following evacuation of the opaque enema. For an historical review of this subject the reader is referred to the articles by Cole and his collaborators, and by Weber (7).

The opaque enema as commonly used is a relatively satisfactory method for demonstrating the size, shape, distribution, and muscular tone of the colon. With its aid, areas of spasm or constriction, diverticula, ulcerations, and gross filling defects may be demonstrated. It is not a satisfactory procedure, however, for demonstrating small polypoid lesions, which are obscured by the volume of opaque material. Small carcinomatous lesions are also easily obscured, especially if the colon is redundant.

After evacuation of the opaque enema, the redundant mucosal folds of the collapsed colon are coated with a thin layer of opaque material. Areas of infiltration of the colonic wall appear as interruptions in the normal lacy pattern, and large polypoid lesions present a widened area of smudged and distorted pattern. Small polypoid lesions resemble the normal mucosal folds and can seldom be identified. The picture is complicated by the frequent presence of retained fecal matter and by failure of complete evacuation of the opaque enema.

The ideal colonic examination would seem to require a combination of the distention provided by the opaque enema and the mucosal coating remaining after evacuation. This is the goal of the double-contrast examination. This procedure should provide a colon well distended with air or gas, the mucosa of which is outlined by a uniform, thin, but easily visualized radiopaque coating.

The double-contrast examination as commonly practised today consists in filling the colon partly or entirely with an opaque enema, permitting evacuation, and then inflating the bowel with air or gas. This usually results in good distention with gas but poor coating with the opaque material. Several years ago, in this department, Dr. Edward Leef attempted to improve matters by modifying the technic of examination. The procedure finally settled upon is essentially the one outlined by Fischer (4) in 1925 and is described in detail below.

Although this modification gave superior results, there were still a distressingly large number of cases in which the coating of the bowel wall was unsatisfactory. In 1948, Dr. Windholz was responsible for the development of a colloidal suspension of barium sulfate for use in examination of the gastro-intestinal tract. A preliminary report of the use of this material has been published (8). When this medium is used in the double-contrast enema, coating of the colon surface is much improved.

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[1] From the Department of Radiology, Stanford University School of Medicine, San Francisco, Calif. Accepted for publication in September 1950.

[2] Deceased.

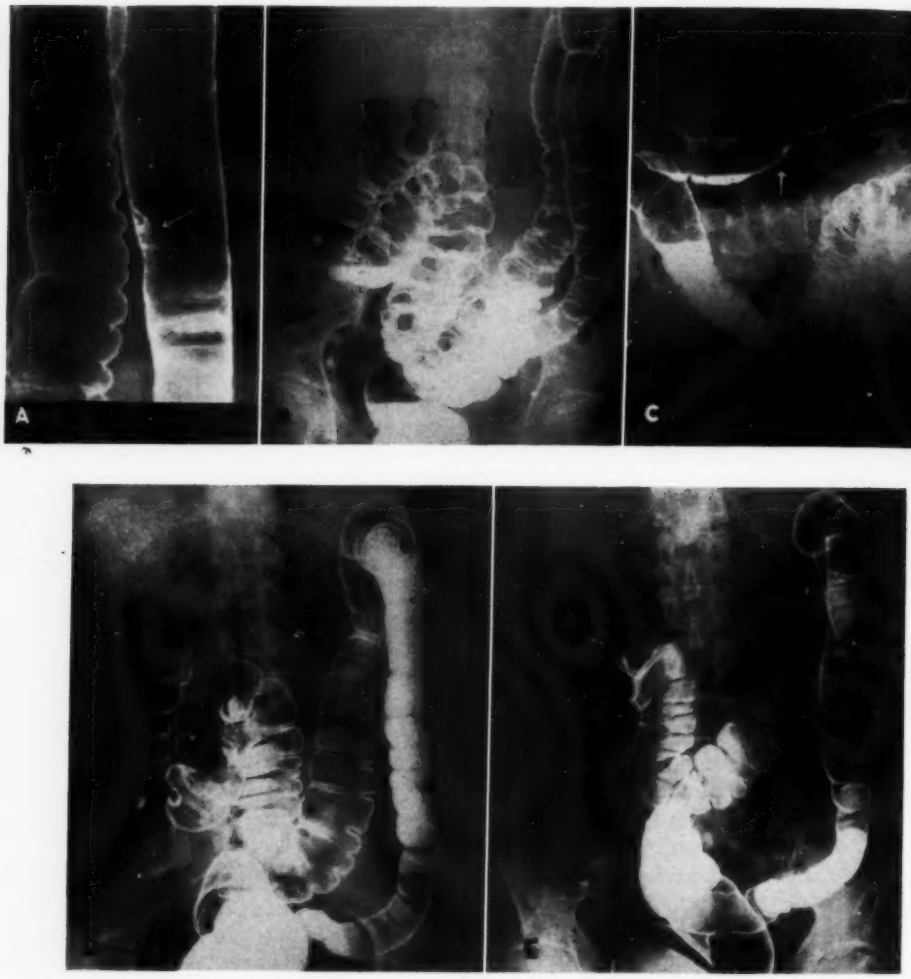

Fig. 1. Polyp in descending colon shown on spot film (A), erect film (B), and right decubitus film (C), but obscured in supine (D) and prone (E) projections.

PROCEDURE

The double-contrast examination is performed as a separate examination. On those occasions when we have attempted it immediately following the opaque enema, residual barium in the distal ileum has obscured the sigmoid and prevented satisfactory visualization.

The bowel must be scrupulously clean. This is best accomplished by the administration of 2 ounces of castor oil after the noon meal on the day before the examination. Stevenson, Moreton, and Cooper in a recent article (6) suggested limiting the dose to 1 ounce in order to minimize the possibility of oil droplet formation in the colon. We have not encountered difficulty from this phenomenon, whereas we have experienced difficulty from incomplete purging when less than 2 ounces was administered. In children the dosage is smaller. In cases in which castor oil does not give good results, cleansing saline enemas are given until the returns are clear. Soapsuds enemas are to be avoided, as they cause bubble formation when the

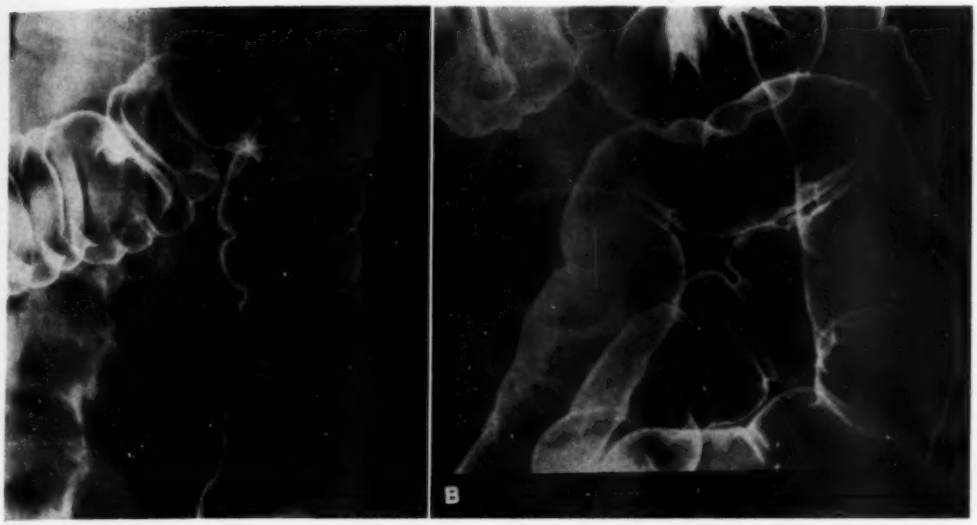

Fig. 2. Spot films showing uniform coating obtained when colloidal barium suspension is used with the procedure described.

air-contrast examination is performed. The last enema should be completed at least two hours before the double-contrast study in order to minimize the amount of retained gas and fluid. A very light meal is permitted on the evening before the examination, but nothing to eat or drink is allowed from 10 P.M. until it is completed.

When the patient arrives at the X-Ray Department, a preliminary anteroposterior film of the abdomen is taken. If inspection of this film reveals evidence of retained fecal material, the examination is cancelled and the patient is given another appointment and instructions to purge more vigorously.

The colloidal barium mixture is rather viscous, and pressure is required to force it through the enema tubing. This may be done by "milking" it down the tube, by a "piston" type syringe, or by any manually operated pumping device. The bowel is filled as far as the mid-descending colon. Patients with a short sigmoid colon and a redundant transverse colon may require filling to the splenic flexure. In patients with a redundant sigmoid it may be necessary to fill only as far as the mid-sigmoid.

After filling with barium, air is introduced, the patient being turned under fluoroscopic guidance during this procedure, so that gravity will assist the air in distributing the opaque medium throughout the colon. Usually this is accomplished by starting with the patient in the left posterior oblique position. When the material reaches the splenic flexure, he is turned to the supine position and then into the right posterior oblique or even into the right lateral decubitus. After the material has reached the cecum, he is turned through a full 360 degrees in order to assure coating of all portions of the bowel wall. Trendelenburg or a slightly erect position may be helpful in conjunction with the above manipulations in certain cases.

Spot films are taken of the sigmoid colon and the flexures. Conventional films are then obtained. Our present routine calls for an erect postero-anterior film, left and right lateral decubitus films, and a postero-anterior Trendelenburg film. The decubitus films may be taken with a grid, although an upright portable Bucky diaphragm is easier to use and gives a better roentgenogram. Further views are taken in particular cases, at the discretion of the fluoroscopist. Formerly our routine in-

Fig. 3. Polyp of mid-descending colon.

cluded prone and supine films, but a review of cases showed that these rarely demonstrated anything which was not better shown on one or more of the other views (Fig. 1).

It is very important that sufficient opaque medium be used to exhibit fluid levels on the films. The success of the method depends on having enough fluid medium to "wash" the bowel walls.

OBSERVATIONS

We have been very gratified with the visualization of the bowel wall afforded by this type of examination. The method seems to be a superior one. This is especially true when the colloidal suspension of barium is used. This has consistently provided us with a uniform, long lasting, semi-opaque coating (Fig. 2) which is ideal for visualization of polypoid lesions. These appear as uniform soft-tissue densities, usually smoothly rounded, projecting into the lumen of the bowel and outlined by a coating of opaque medium (Fig. 3). An occasional polyp possesses a long pedicle which permits movement up or down the colon for considerable distances. This apparent change in position may be confusing. Frequently the pedicle can be made out as a slender linear soft-tissue density extending from the polyp to the bowel wall. Sometimes the polyp may fall within a pool of the barium suspension, in which case it will appear as a relatively radiolucent area (Fig. 4), or it may be obscured entirely. A polypoid lesion occurring in a segment of bowel which is running toward

Fig. 4. Spot film of polyp on pedicle, showing as a radiolucent area in a pool of barium.

or away from the observer may be mistaken for a fold or bend. Multiple projections are essential to correct interpretation. On several occasions we have demonstrated polyps less than 0.5 cm. in diameter which were verified by operation (Fig. 5).

Diverticula, air-bubbles, and retained feces often simulate polyps. Diverticula (Fig. 6) can usually be thrown clear by manipulation under fluoroscopic guidance, and a spot film taken in the proper projection will show the diverticulum projecting out from rather than into the lumen of the bowel. Air bubbles can usually be differentiated by their transient character, thin radiolucent center, and the dense, uniform, very sharply demarcated margin. Feces may be impossible to differentiate

from a polyp, especially when firmly adherent to the bowel wall. *For this reason, every positive finding must be checked by demonstration on at least two separate examinations,* usually carried out about a week apart. The importance of the confirming examination cannot be too strongly emphasized. On several occasions we have been absolutely convinced of the diagnosis of a polypoid lesion only to have it fail to appear on subsequent examination. We have not experienced difficulty in re-

Fig. 5. Spot film showing polyp 5 mm. in diameter, April 3, 1950. This polyp was subsequently demonstrated on April 20 and was proved at operation.

demonstrating true lesions on the second examination (Fig. 5).

SUMMARY

A modified double-contrast method of examination of the colon for the demonstration of polypoid lesions is described. A special colloidal barium preparation is used for the enema, followed by the introduction of air. Spot films of the sigmoid and flexures are taken, and conventional films are obtained in the following positions: erect postero-anterior, right and left lateral decubitus, postero-anterior Trendelenburg. In the event of a positive finding, a second confirming examination is carried out after an interval of about a week.

Fig. 6. Diverticula showing similarity to polyps unless thrown into profile.

ADDENDUM: Moreton, Cooper, and Foegelle (Radiology **56:** 214–221, February 1951) recently described a one-stage double-contrast technic which is essentially identical with that which we have employed except for the use of another type of barium preparation and of stereoscopic prone and supine rather than the decubitus and erect projections recommended here.

Stanford University Hospitals
Clay and Webster Sts.
San Francisco 15, Calif.

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SUMARIO

El Examen en Aero-Contraste del Colon con Bario Coloidal

Esta técnica de examen en doble contraste del colon ha resultado en particular útil en del descubrimiento de lesiones polipoideas. Tras una escrupulosa limpieza del intestino con aceite de ricino, o enemas si fuere menester, se llena el mismo con una mezcla de bario coloidal, por regla general hasta la mitad del colon descendente. Introdúcese entonces aire, virándose el enfermo bajo dirección roentgenoscópica a fin de asegurar la distribución del medio opaco por todo el colon. Se toman radiografías instantáneas de la S ilíaca y de las flexuras sigmoideas, y después se obtienen radiografías corrientes en las siguientes posiciones: postero-anterior erecta, decúbito lateral izquierdo y derecho y Trendelenburg postero-anterior. Todos los hallazgos positivos son comprobados en otro examen ejecutado al cabo de una semana.

Los pólipos aparecen en forma de condensaciones uniformes de tejido blando, por lo general redondeadas y lisas, que proyectan en la luz del intestino y demarca una capa de bario.

Pneumomediastinum in the Newborn

Report of a Case[1]

EUGENE J. KEEFFE, M.D., and CLIFFORD F. JONES, M.D.
Santa Barbara, Calif.

PNEUMOMEDIASTINUM in the newborn, occurring without pneumothorax, is a rare condition. In 1853, 2 cases of mediastinal emphysema of the newborn were recognized postmortem (1). Gumbiner and Cutler (2) reported several cases and were able to collect 8 additional examples from the literature. Davis and Stevens (3), DeCosta (4), and Heald and Wilder (5) all reported cases of pneumomediastinum associated with pneumothorax. Cases of pneumomediastinum in childhood were also published by Montalvo (6) and Sims (7), but their papers, appearing in foreign journals, were not available for review. In 1945, Lowman and Culotta (8) described 2 cases. One of their patients had a pneumomediastinum associated with a bilateral pneumothorax, which proved fatal. The other had pneumomediastinum alone and survived.

During the senior author's residency at St. Joseph's Hospital, Ann Arbor, Mich.,[2] 1944–48, no proved case of pneumomediastinum was observed in routine anteroposterior and lateral roentgenograms of over 4,000 newborn infants.

Kelman (9) injected the trachea of rabbits with air, thereby increasing pulmonary pressure and producing mediastinal emphysema without pneumothorax. Sections of the lungs of these animals revealed rupture of many alveolar walls and distention of interstitial tissue with air. Jessup (10) states that a large quantity of air may remain in the mediastinum and not escape to other tissues. Macklin (11) demonstrated that artificial over-distention of a portion of the lung produced alveolar rupture with passage of air along the vascular sheath to the mediastinum. Rupture of mediastinal blebs into pleural cavities may produce unilateral or bilateral pneumothorax. The extension of compressed air along the great vessels in the cervical or axillary interspaces, or downward into the retroperitoneal region and/or along the blood vessels to the groins to produce subcutaneous emphysema of that region, may also occur. It is interesting that in all the cases of pneumomediastinum which have been reported some form of artificial respiration had been administered.

Mediastinal emphysema occurring during the first few days of life is usually manifested by respiratory and circulatory distress. Respiration is rapid and shallow and associated with dyspnea and/or cyanosis. The diagnosis of pneumomediastinum is a roentgen procedure and it is important that radiographs should be obtained both in the anteroposterior and lateral projections, as there is often no abnormality noted in the frontal projection. In the lateral view, marked bulging of the precordium with a large area of encapsulated air immediately posterior to the sternum is characteristic of pneumomediastinum.

One condition which might simulate pneumomediastinum is atelectasis and compensatory emphysema of the contralateral lung. The emphysematous lung seen in the lateral view causes an abnormal radiolucency in the region of the anterior mediastinum. This condition should not give rise to confusion, however, as the atelectasis and emphysema should be evident in the anteroposterior projection.

Jessup considers two types of treatment: the first, the use of oxygen and stimulants; the second, aspiration of the air from the mediastinum.

[1] From the Department of Radiology, St. Francis Hospital, Santa Barbara, Calif. Accepted for publication in September 1950.
[2] S. W. Donaldson, M.D., Director.

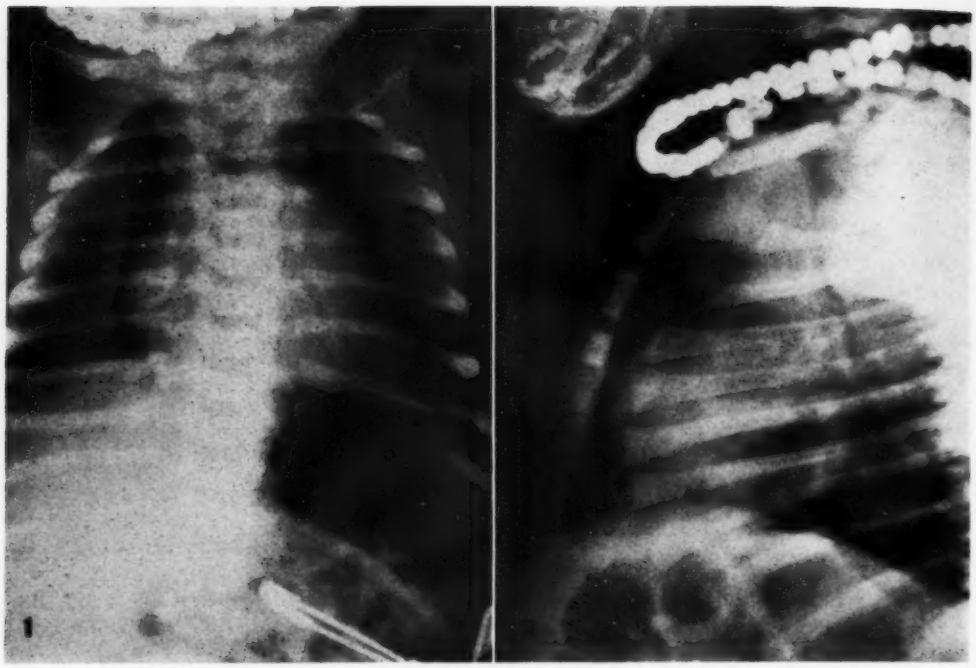

Fig. 1. Anterior projection, May 9, 1950, demonstrating no abnormality.
Fig. 2. Lateral projection, May 9, 1950, showing air in the anterior mediastinum extending from the anterior diaphragmatic angle to the region of the thymus.

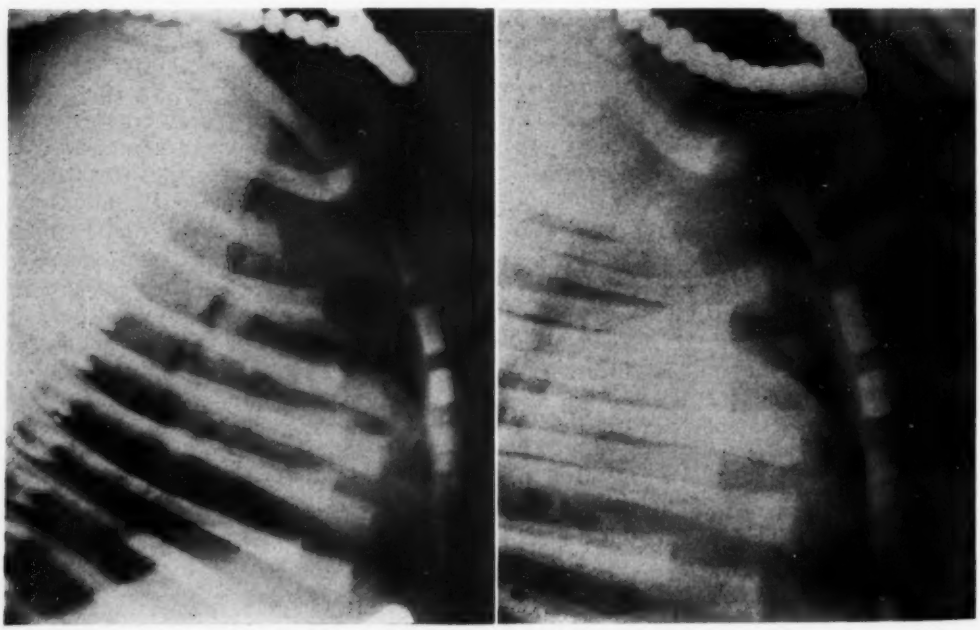

Fig. 3. Lateral view of the chest, May 13, 1950, demonstrating a small amount of air remaining posterior to the first and second centers of ossification of the body of the sternum.
Fig. 4. Lateral view, May 15, 1950, revealing less air in the anterior mediastinum.

CASE REPORT

D. E., a girl, was born May 8, 1950. Presentation was in a left bregmatic anterior position and delivery was accomplished with difficulty, with the aid of Kielland forceps. The child did not breathe or cry, and artificial respiration was given by pressure over the thorax. Mucus was removed from the throat and nostrils by intratracheal suction. Stimulants were given, the child cried, and respirations began.

Physical examination revealed no significant abnormalities. The child was placed under oxygen and respirations were rapid, at the rate of 50 per minute. On May 9, 1950, sixteen hours later, the temperature was 103° and the respirations were rapid and jerky. Fluoroscopy and films at this time revealed no abnormality except in the lateral view. In this position a sharply delineated translucent shadow of encapsulated air could be seen in the anterior mediastinal region, immediately posterior to the posterior margin of the manubrium. The thymus appeared to be elevated, but there was no compression of the trachea (Fig. 1 and 2). A diagnosis of pneumomediastinum was established, and the patient was returned to the oxygen tent.

The pediatrician was consulted and it was decided that if the respiratory distress continued, aspiration of the air from the anterior mediastinum should be instituted. The child definitely improved, however; respirations decreased, temperature became normal, and on May 13, films of the chest revealed a decrease of air in the anterior mediastinum (Fig. 3). When the infant was discharged from the hospital on May 15, in normal condition, roentgenograms revealed even less air in the upper anterior mediastinum behind the body of the sternum (Fig. 4).

After discharge there was no recurrence of dyspnea. Check-up examination on June 7, 1950 revealed a normal infant's chest with no air in the anterior mediastinum as demonstrated in the lateral view (Fig. 5).

Fig. 5. Lateral view June 7, 1950. No abnormality.

SUMMARY

1. Pneumomediastinum in a newborn infant is a rare condition and can produce an unusual clinical picture.

2. It is significant that in all the reported cases of pneumomediastinum, some form of artificial respiration had been given.

3. Adequate roentgen examination of the chest demands fluoroscopy and anteroposterior and lateral films. The lateral film demonstrating the air in the anterior mediastinum is pathognomonic of this condition.

4. In most of the cases described in the literature, as in the one here reported, the course was uneventful.

NOTE: Appreciation is expressed to Dr. F. B. Zener, of the Department of Obstetrics, for his assistance in the preparation of this paper.

14 West Micheltorena Street
Santa Barbara, Calif.

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SUMARIO

Neumomediastino del Recién Nacido. Presentación de un Caso

El neumomediastino del recién nacido sin neumotórax es un acontecimiento extraño. Suele traducirse por malestar respiratorio y circulatorio, con respiración rápida y superficial y disnea y/o cianosis. El diagnóstico se hace roentgenológicamente por el descubrimiento, en vista lateral, de una combadura del precordio, con una gran zona de aire encapsulado inmediatamente detrás del esternón. Frecuentemente, no hay anomalía distinguible en la proyección frontal.

En el caso comunicado, como sucedió en todos los casos descritos en la literatura, se había administrado antes respiración artificial. También, como en la mayoría de dichos casos, la evolución no mostró contratiempo. Colocado el niño en una tienda de oxígeno, el estado mejoró rápidamente.

Benign Polyp of the Ampulla of Vater[1]

HUGH P. SMITH, JR., M.D., and WILLIAM S. BLAKEMORE, M.D.[2]

Philadelphia, Penna.

BENIGN TUMORS of the ampulla of Vater are rarely encountered in clinical practice but at least twenty symptomatic cases have been reported (1–19). Details of these cases are set forth in Table I. The present case is apparently the second in which roentgenograms clearly revealed the lesion.

Fig. 1. A. Cholangiogram showing the oval filling defect at the lower end of the common bile duct. B. Enlargement of A.

CASE REPORT

A 54-year-old white woman was admitted to the Hospital of the University of Pennsylvania on Dec. 9, 1949, complaining of abdominal pain and jaundice for forty-eight hours. She gave a twenty-year history of upper abdominal complaints compatible with the diagnosis of gallbladder disease, and complained of increasing indigestion after meals in recent months. Two nights prior to admission she awoke with severe pain in the right upper quadrant of the abdomen, accompanied by vomiting, chills, and fever. Her physician reported jaundice. Her symptoms became worse during the next forty-eight hours and she was admitted to the hospital.

Physical examination revealed a deeply jaundiced patient in obvious distress, with great tenderness in the right upper quadrant of the abdomen, where a rounded palpable mass was thought to be the gallbladder. The serum bilirubin was 3.5 mg. per 100 c.c. direct, and 6.1 mg. total; serum amylase 272 units. A single abdominal film did not show any opaque calculi in the region of the gallbladder.

The following day, operation by Dr. I. S. Ravdin revealed a huge, distended, edematous gallbladder. The common duct was 2 cm. in diameter and, although no stones were found, the possibility was entertained that a stone in the ampulla could have

[1] From the Departments of Radiology and Surgery, and the Harrison Department of Surgical Research, Hospital of the University of Pennsylvania, and Schools of Medicine of the University of Pennsylvania, Philadelphia, Penna. Accepted for publication in August 1950.

[2] Damon Runyon Fellow in Clinical Research.

TABLE I: BENIGN TUMORS OF THE AMPULLA OF VATER

Author and Date	Sex and Age	Icterus	Gall-stones	Size of Tumor	Type of Operation	Result	Type of Tumor
1. Calzavara, 1895	M ...	...	...	"Pea"	.....	Death	Adenoma
2. Krause, 1901	...	...	...	...	.....	...	Polyp
3. Duval, 1908	M 44	Yes	No	2.5 cm.	Cholecystostomy	Death	Melanoma
4. Stein, 1910	F 37	Yes	No	...	Duodenotomy; curettage; cauterization	...	Papilloma
5. Brentano, 1920	M 45	Yes	Yes	"Plum"	Retroperitoneal removal	Cure*	Carcinoid
6. Sundberg, 1920	M 53	...	...	"Goose-egg"	.....	...	Papilloma
7. Christopher, 1933	F 74	No	Yes	0.5 cm.	Cholecystostomy	Death	Adenoma
8. Landivar, 1934	M 49	Yes	No	"Olive"	Duodenotomy; resection of ampulla	Cure	Papilloma
9. Cabot Case, 1936	F 55	Yes	Yes	1.0 cm.	Choledochostomy	Death	Papilloma
10. Castleman, 1936	...	...	...	...	.....	...	Papilloma
11. Mallet-Guy, 1939	F 56	Yes	Yes	"Grain of corn"	Duodenotomy; local resection	Cure	Assumed to be benign
12. Horsley, 1941	M 60	Yes	No	1.5 cm.	Whipple	Death	Adenoma
13. Brunschwig, 1942	M 39	No	No	0.1 to 0.3 cm.	Duodenotomy; local excision	Cure	Lymphangiomas (three)
14. Grove and Rasmussen, 1944	M 59	Yes	No	"Walnut"	Duodenotomy; local excision	Cure?	Papilloma?
15. del Valle and Sanchez Zinny, 1946	F 49	Yes	No	"Chick pea"	Duodenotomy; resection of ampulla	Cure	Adenoma
16. Wilson, 1946	...	...	...	...	.....	...	Papillary adenoma
17. Baker and Caldwell, 1947	M 49	Yes	No	...	No resection; cholecystoduodenostomy	Cure	Papilloma
18. Cattell and Pyrtek, 1950	F 53	No	No	0.4 cm.	Duodenotomy; local excision	Cure	Papilloma
19. Cattell and Pyrtek, 1950	F 33	No	No	0.4 cm.	Duodenotomy; local excision	Cure	Papilloma
20. Wheelock *et al.*, 1950	M 64	Yes	No	0.5 cm.	Duodenotomy; resection of ampulla	Cure	Adenomatous papilloma
21. Present case, 1951	F 54	Yes	No	1.0 cm.	Duodenotomy; local excision	Cure	Adenomatous polyp

* That is, apparently well up to time of report.

passed into the duodenum during the operative procedure. A cholecystectomy was performed and a T-tube was left in the common duct.

Improvement was rapid. On Dec. 19, a cholangiogram revealed, at the duodenal end of the common duct, a filling defect which was interpreted as a gallstone (Fig. 1). Attempts were made to dissolve the stone, but the defect was again visualized when the cholangiogram was repeated on Dec. 30. The patient was discharged and readmitted one month later for re-exploration of the common duct. She had been feeling well in the interim.

On Jan. 30, 1950, laparotomy revealed that the common duct was still greatly enlarged, but when it was opened, no stone was found. The duodenum was opened in its long axis and appeared normal. The ampulla of Vater was incised, and in its opening was a small polyp, which was excised. The wounds healed satisfactorily. Cholangiography was again done on Feb. 7, 1950, and the filling defect was no longer demonstrable.

The pathological diagnosis was: "polyp (adenomatous type) of the papilla of Vater."

DISCUSSION

The true incidence of benign tumors in the ampulla of Vater is uncertain. Baggenstoss (20) found 4 polyps during the careful dissection of 100 ampullas. He also reported 25 benign polyps recorded as incidental findings at autopsy. None were found in a similar study of 150 cases by Howard and Jones (21, 22), in which they dissected the ampulla and carefully measured the type and extent of the communication between the pancreatic and common bile ducts. No benign tumors of the ampulla are indexed in the pathological records of this university.

Cattell and Pyrtek (18) have recently reported 2 cases of benign ampullary tumors, together with 4 carcinomas of the same region, and they present pathological

evidence supporting the belief that the malignant lesions probably arose from benign polyps. Carcinomas of the ampulla are more commonly found than benign tumors, suggesting that the latter seldom cause obstructive symptoms and so are seldom diagnosed. Only when a malignant growth causes obstruction of the biliary or pancreatic secretions is it likely to be detected. Because of the strategic location, slight enlargement of the tumor causes early blockage of the common bile duct with resulting jaundice, which may be intermittent. Bleeding from the tumor may lead to gross melena or persistent occult blood in the stool. Pain may resemble that of biliary colic, pancreatitis, or carcinoma of the pancreas. Cattell and Pyrtek point out that recurrent symptoms after cholecystectomy should suggest the possibility of a tumor of the ampulla rather than the diagnosis of "biliary dyskinesia." This is illustrated by the case recorded here and that of Mallet-Guy (11).

Special note should be made that these tumors are quite small and hard to find at operation. Carcinoma of the ampulla is infrequently associated with gallstones, in contrast to carcinoma of the gallbladder, where stones are almost always found. When dilatation of the common duct is noted during cholecystectomy, especially if no stones are present, the region of the ampulla of Vater should be checked. The fact that a probe may be passed into the duodenum does not eliminate the possibility of an ampullary tumor (11, 13). Duodenotomy is usually required and, as in the present case, it may even be necessary to incise the ampulla itself in order to rule out the presence of these soft, small tumors.

The interesting lesion revealed by the cholangiogram in the case reported here is the second of this kind to be reported. It resembled a gallstone impacted at the lower end of the common duct. Mallet-Guy (11) previously described a case in which repeated choledochotomies were necessary for common duct stones. After removing a stone from the common duct at the fourth operation, lipiodol was injected through the T-tube and roentgenograms were made on the operating table. These showed obstruction in the ampulla of Vater, and after duodenotomy a small polyp prolapsing through the ampulla was found and removed.

Except for cholangiograms, the only way to reveal ampullary tumors is by means of the barium meal roentgen study. If the lesion is large enough, one might find a small duodenal intraluminal polypoid defect, enlargement of the ampulla, or an extraluminal pressure defect. Large tumors may cause duodenal stenosis. Dilatation of the common bile duct may be revealed by a pressure defect in the superior duodenum (23).

SUMMARY

An unusual case of benign polyp in the ampulla of Vater is presented. In the roentgenograms this closely resembled a gallstone. These tumors should be considered in surgical and roentgenological diagnosis, especially when no stones are found at operation.

NOTE: The authors gratefully acknowledge the kindness of Dr. I. S. Ravdin, John Rhea Barton Professor of Surgery, University of Pennsylvania, for permission to report this case.

206 East North St.
Greenville, S. C.

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SUMARIO

Pólipo Benigno de la Papila de Santorini

La literatura contiene 20 casos de tumor benigno de la papila duodenal que se presentan aquí en forma tabular. Comunícase además 1 caso que parece ser el segundo en que las radiografías revelaron claramente la lesión. Tratábase de un pequeño pólipo observable en la radiografía en forma de nicho, que se tomó por un cálculo biliar. La verdadera naturaleza de la lesión no se determinó sino al incindir la papila al operar.

Señálase que, cuando se observa durante la colecistectomía dilatación del colédoco, sobre todo no habiendo cálculos, debe investigarse la región de la papila de Santorini.

Cervical Hernia of the Lung

WILLIAM L. PALAZZO, M.D.,[2] and THOMAS A. GARRETT, M.D.[3]

UP TO APRIL 1946, ONLY 185 cases of hernia of the lung had been recorded in the literature. In 1949, Mann, Olson, and Walls (1) reported another case following trauma to the anterior chest wall.

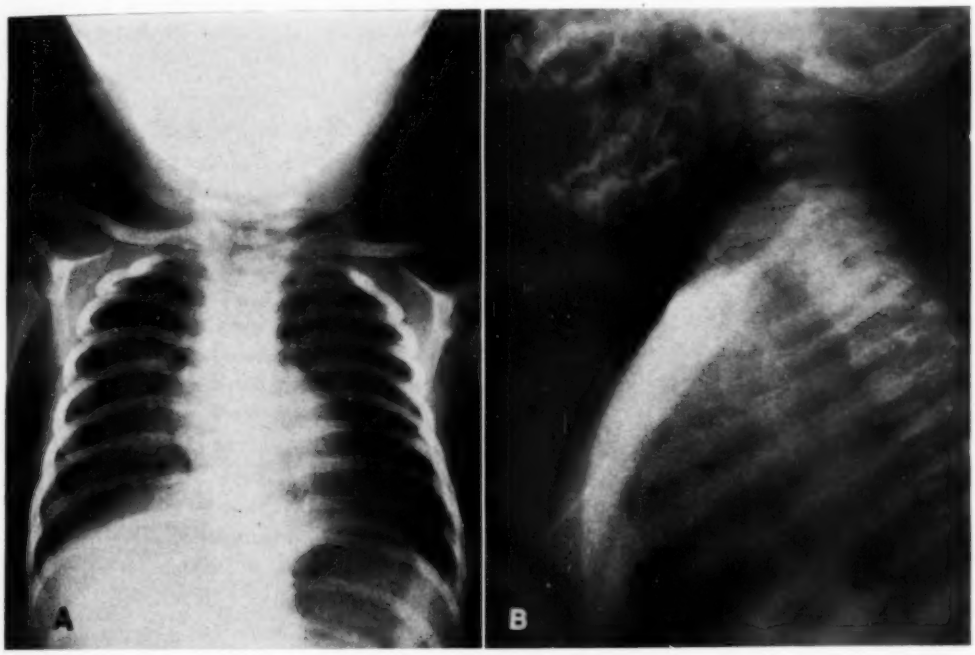

Fig. 1. A. Postero-anterior film showing bilateral cervical hernias of the lung. B. Lateral film showing the larger of the hernias, on the left side.

Maurer and Blades (2), who reviewed the literature in 1946, found records of 16 cervical lung hernias. All were unilateral, and most were in patients giving a definite history of trauma. Van Wezel (3) has recently reported what he states to be the first recorded case of bilateral cervical hernia of the lung. The patient was a man of thirty-nine years, with no history of trauma.

Van Wezel has adequately summarized the mode of occurrence. "Cervical hernia usually occurs through the superior aperture of the thorax in the space between the sternocleidomastoid muscle and the scalenus anticus muscle, either as a tear in the traumatic cases or as a deficiency in Sibson's fascia in the congenital group."

The following case is reported because (*a*) it also is bilateral, and (*b*) the patient is believed to be the youngest recorded with this condition.

CASE REPORT

L. P. M., Jr., was born on Feb. 25, 1950, after a labor of six hours and ten minutes. He was a second child. Labor was normal, and low forceps

[1] Accepted for publication in July 1950.
[2] Radiologist, Holy Name Hospital, Teaneck, N. J.
[3] Attending Pediatrician, Holy Name Hospital, Teaneck, N. J.

were used. Respiration was immediate. Physical examination revealed (*a*) a cleft lip (severe, left); (*b*) cleft palate (complete and wide); (*c*) deformity of the nose, consisting of rotation of the columella to the right, producing obstruction in the formed nasal aperture; (*d*) deformity of the maxillas, which appeared more widely separated than usual; (*e*) the mandible slightly smaller on the left side; (*f*) deformity of the ears.[4] The birth weight was 3,890 gm. (8.6 lb.), but this fell to 3,160 gm. (7.0 lb.) in twenty-five days. The child presented a definite feeding problem, since his deformities caused frequent aspiration of his formula. The temperature was elevated on several occasions, reaching 101.2° F. on March 28, and 101.4° on April 16 and 17. On April 17, the child's color was poor and he was irritable. In the right lower lobe there were signs of localized pneumonitis, probably following aspiration. He recovered and was discharged May 2, with plans for surgery for the congenital defects of the face at a later date.

An x-ray film of the chest obtained on April 13 (Fig. 1) shows a hernia of the lung in the left supracostal region, measuring 2.0 cm., and a smaller one in the right supracostal region, measuring 0.8 cm.

[4] These observations were made by Dr. John F. Daly, ENT consultant.

SUMMARY

A case of cervical hernia of the lung is reported. The case is of interest because of the rarity of cervical pulmonary hernia, because it is the second such bilateral hernia to be recorded, and because it was discovered on the forty-eighth day of life. The patient also had cleft lip and palate, and it is suggested that the herniated lung may be the result of a congenital defect.

Holy Name Hospital
Teaneck, N. J.

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SUMARIO

Hernia Cervical del Pulmón

Este caso de hernia cervical del pulmón reviste interés, por la rareza del estado, por ser el segundo bilateral que se haya descrito, y por haber sido descubierto a los 48 días del nacimiento del enfermito. Este tenía además labio leporino y paladar bífido, y la hernia pulmonar puede muy bien haber sido consecuencia de un vicio congénito del desarrollo. La hernia fué descubierta roentgenográficamente.

A Colorimetric Dosimeter for Qualitative Measurement of Penetrating Radiations[1]

GEORGE V. TAPLIN, M.D., and CLAYTON H. DOUGLAS, B.S.

School of Medicine, University of California at Los Angeles

SHORTLY AFTER the discovery of natural radioactivity by the Curies and Becquerel and of x-rays by Roentgen (1), during the latter part of the nineteenth century, the problem of radiation measurement arose. The first dosimeters depended upon the fluorescence of the platinocyanide of barium in the presence of roentgen or gamma radiation (2). This material was known to change from its normal green color to orange and then to various shades of brown following irradiation. Barium platinocyanide was the primary chemical ingredient of pastilles, developed by several investigators. The main disadvantage of these pastilles is that the color quickly reverts to the original green during exposure to light (2). Also, the color standards in the comparator charts gradually fade and contribute to inaccurate measurements. Freund (3), in 1904, utilized the effect of roentgen radiation on various iodine compounds. A mixture of iodoform and chloroform was found to be sensitive to irradiation (and was used in dosimetry), but the reaction was also produced by heat, light, and oxygen and was not proportional to dosage.

According to Günther *et al.* (4), in 1928, chloroform irradiated with x-rays liberates hydrochloric acid in amounts proportional to the radiation energy transmitted. Acid formation was shown to be increased in water solutions, in which approximately 50 per cent of the acid consisted of hypochlorous acid. It was also found that irradiation of chloroform solutions by the gamma rays of radium resulted in acid evolution.

During the past twenty years, numerous studies cited by Clark (5) have shown that chemical changes are induced in various other substances on exposure to penetrating radiation, such as the oxidation of ferrous to ferric iron compounds, denaturization of proteins, reduction of potassium permanganate and of ceric to cerous ions, decolorization of methylene blue, liberation of free iodine from iodine compounds, and inactivation of certain enzymes in dilute aqueous solutions (6–8). Numerous other reactions are listed by Lea (9) in his text. Recently it has been shown that ethyl iodide liberates free iodine in direct proportion to the roentgen or beta ray energy input (10). Also, solutions of 2,3,5-triphenyltetrazolium chloride are reduced to their red, water-insoluble formazan by x-rays and by ultraviolet and gamma radiation (11).

CLASSIFICATION OF ATOMIC RADIATION CASUALTIES

With the development of nuclear energy and its applications to warfare and possibly to industry as a source of power (12), it has become important to develop a simple, inexpensive radiation-measuring device which will register immediately the amount of penetrating radiation received by individuals or reaching certain fixed areas within a community (13–15). Such a device should be able to indicate penetrating radiation (gamma) exposure in three ranges: 200 r or less, 200 to 400 r, and 400 to 600 r. These values are estimates made by Jacobson *et al.* (16) and are in accord with estimations made by numerous other investigators (17–19), though they may require future revision. They are based on the results of animal experimentation (20–22), the effects of the atomic bomb on the Japanese (22–25),

[1] This paper is based on work performed under contract No. At-04-1-GEN-12 between the Atomic Energy Commission and the University of California at Los Angeles. Accepted for publication in April 1950.

and the effects of total-body irradiation for therapeutic purposes (19).

Dosage in the first range is expected to produce transient decreases in the circulating white bood cells followed by complete recovery in nearly all individuals. Exposure to 200 to 400 r would probably cause a moderately severe fall in white cells, platelets and red cells, severe nausea, vomiting and diarrhea, plus moderate hemorrhagic manifestations. While the late effects of this amount of radiation have not been determined, it is probable that only a small fraction of persons receiving this dose would succumb in the immediate post-irradiation period. Exposure to 400 to 600 r of penetrating radiation would nearly always cause serious illness, with all the symptoms and manifestations of the radiation syndrome. It is estimated that at least 50 per cent of a group of individuals exposed to doses in this range would eventually die from the effects. However, persons absorbing this amount of radiation would require the major expenditure of time and effort by medical personnel. With exposure to more than 600 r, on the basis of present information, few persons would be likely to survive even with the best medical care.

No rapid clinical methods (13) of diagnosis have been discovered by which a medical classification of casualties could be made at the time of an atomic catastrophe, in respect to the amount of radiation absorbed, especially when burns and blast effects are also manifest (26, 27). Particularly is this true of an air detonation, which is associated with an instantaneous release of penetrating radiation along with heat, blast, and other radiations involving the whole electromagnetic spectrum (28). Individuals exposed to 1,000 r might not be any more uncomfortable, or present different physical signs, than those absorbing half that amount. With the aid of a measuring device whereby a rapid classification could be made according to the approximate amount of radiation absorbed, supportive therapy could be limited to those amenable to medical measures, and more lives might thus be saved.

AVAILABLE RADIATION DETECTION EQUIPMENT

No monitoring device will measure accurately roentgen or gamma radiations with a broad energy range (0.1–10.0 mev). All types of radiation-measuring equipment must be standardized against standard sources because of wave length dependence and other factors (29). The proteximeter, for example, is a relatively costly electronic apparatus, the accuracy of which is modified by jarring, temperature changes, and alterations in barometric pressure and humidity. The pocket dosimeter, a miniature electroscope, has similar disadvantages, and its sensitivity is far too high (0–200 mr.) to measure the quantities of radiation which are likely to be encountered. Film badges, originally designed to record low dosage radiation, have been altered to measure amounts in the ranges mentioned above (30), but they have the disadvantage of requiring photographic development, which is time-consuming and cumbersome in an emergency, as well as an expensive densitometer for accurate readings. Nearly all of the electronic measuring devices, which incorporate ionization chambers, require delicate electrical amplifying circuits and are highly susceptible to the effects of blast, flash, and short circuits. Instruments of this type are far more useful for measuring persisting radiation following an explosion, particularly in the delineation of safe areas and protection of relief personnel.

THEORETICAL CONSIDERATIONS REGARDING RADIATION EFFECTS ON WATER AND AQUEOUS SOLUTIONS OF ORGANIC COMPOUNDS

The importance of water in solutions of various organic chemicals was first investigated and described by Fricke (31–33). Later, Weiss (34) introduced the free radical concept. Others have stressed the biological significance of this theory

(35, 36). According to Lea, the biochemical effects of penetrating radiation may be largely related, indirectly, to chemical changes in water. The chemical effects produced by irradiating certain inorganic compounds and some simple organic compounds in aqueous solutions have a linear proportionality to radiation dosage (37). Most of these reported chemical reactions require relatively tremendous doses of radiation (kiloroentgens). Acid evolution from aqueous solutions of chloroform following penetrating radiation exposure is far greater than could be caused by secondary ionization only (5). Also, it has been shown that the quantity of acid produced is increased many times by the presence of small quantities of water (4). An explanation of this relatively high degree of acid production is that the reaction is of a chain type, of short duration, and acid formation is increased by the presence of alcohol, water, and alkali. It is probably because of this chain reaction that chloroform has not been used in dosimetry, although its reaction products and high sensitivity to radiation have been known for many years (4).

PRELIMINARY EXPERIMENTS

The first compound studied by us was ferrous sulfate, which has long been known to be oxidized by radiation (38). Dilute aqueous solutions of ferrous sulfate mixed with potassium thiocyanate as an indicator were found to react colorimetrically following x-irradiation, but the sensitivity of this system was not great enough to provide a means of measuring radiation in the required dosage range. Subsequently, dilute solutions of potassium iodide and starch were tested; iodoform and starch, and mercury compounds, were similarly investigated. All were found to be far too insensitive to x-radiation to have any practical applicability as personnel dosimeters.

Later, chloroform and carbon tetrachloride mixed with 95 per cent alcohol in a 1:1 ratio were studied in regard to the quantity of acid evolved following x-irradiation. The work of Günther *et al.* was confirmed (4). Both compounds were found to be relatively sensitive to x-rays and to gamma radiation. To measure the acid evolution colorimetrically in a single-phase system, it was necessary to add the dye to either compound in alcohol, since aqueous dye is immiscible. Bromcresol green was found to be a suitable indicator.

If the chemical reactions produced by penetrating radiation in a colorimetric dosimeter are to be utilized, it is essential that the active reagents be shock-proof and stable under wide variations of temperature and exposure to light, ultraviolet light, and other long electromagnetic rays. A personnel or area radiation-measuring device should be unaffected by such factors for at least twenty-four to forty-eight hours following the irradiation and for six months or more prior to such exposure.

Suitable temperature studies using carbon tetrachloride or chloroform mixed with alcoholic bromcresol green revealed chemical instability when the samples were exposed to temperatures above 37° C. At lower temperatures both are relatively stable, the chloroform mixtures being more so than those containing carbon tetrachloride.

Factors causing instability to heat were investigated. Commercial chloroform and washed carbon tetrachloride are relatively stable at 56° C. when exposed in pyrex glass containers. When alcohol is added, however, there is a rapid evolution of acid at temperatures above 37° C. The presence of sodium or potassium hydroxide in the chloroform or carbon tetrachloride mixtures also increases the instability at high temperatures. Therefore, inorganic alkali and alcohol were eliminated. Bromcresol green dissolved in acetone is also soluble in chloroform and carbon tetrachloride. However, the *p*H value of wet and dry chloroform and carbon tetrachloride mixed with the dye is below the end point of the indicator (bromcresol green), and this necessitates the use of alkali prior to irradiation. By substitut-

ing piperazine for potassium hydroxide, the *p*H of the mixture is adjustable to the mid range of the indicator. Such mixtures are relatively sensitive to x-radiation and are fairly stable to heat. Unfortunately, the color reaction fades after twenty hours exposure at temperatures between 56–58° C.; also, the dye tends to precipitate out of solution.

THE USE OF TWO-PHASE SYSTEMS

Because *p*H indicator dyes are relatively heat-stable in aqueous solution and commercial chloroform and carbon tetrachloride also have this property, it was decided to use chloroform overlayered with a *p*H indicator dye in pure water. Distilled water separated from chloroform following shaking was neutral or only slightly alkaline, ranging between *p*H 7.2 and 7.4. This observation made it possible to use *p*H indicator dyes which react near neutrality. It is well known that extremely small amounts of acid added to neutral water cause large reductions in *p*H. Also, the affinity of hydrochloric acid for water is far greater than it is for chloroform. Thus, slight shaking washes the greatest fraction of HCl present in chloroform (18) into the aqueous layer of a two-phase system (chloroform overlayered with water). Preliminary x-irradiation experiments using the two-phase chloroform-aqueous dye systems indicated that the radiation sensitivity was well within the range required for the purposes intended (200–600 r), while heat stability tests demonstrated the superiority of the two-phase system over chloroform-alcohol-dye mixtures. Of the three *p*H indicator dyes available, reacting in the proper range (*p*H 6.8–5.2)—namely, bromcresol purple, bromthymol blue, and chlorophenol red—bromcresol purple was selected for showing a distinctly visible color reaction (purple-yellow). Chloroform overlayered with an aqueous solution of any one of the three dyes is stable at 56–58° C. for at least twelve weeks. The same systems are resistant to near-freezing temperatures (3° C.) and to frequent shaking before and after exposure to x- and gamma radiation. Also, the three dyes in aqueous solution are not affected by either x-radiation or gamma radiation in doses as high as 3,000 r.

METHODS, EQUIPMENT, AND CHEMICAL USED

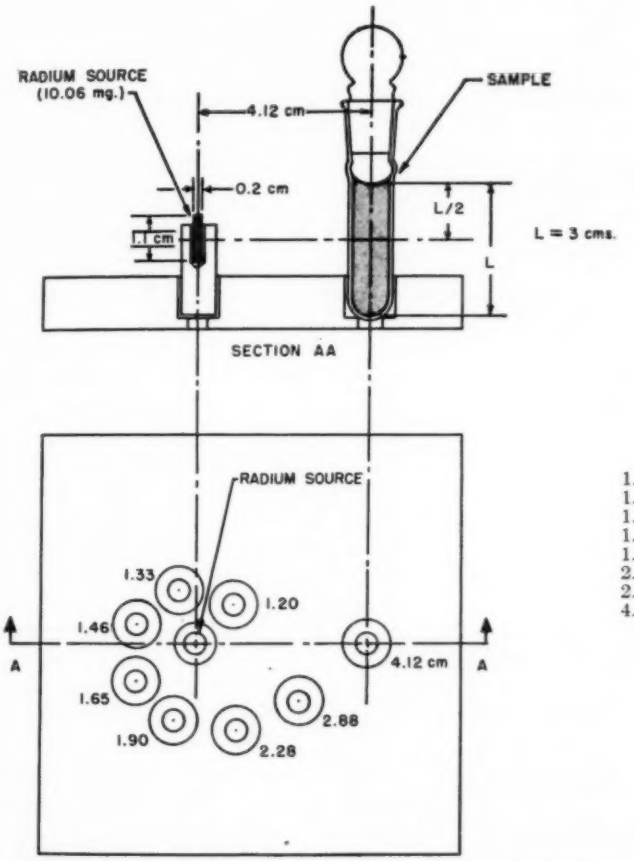
Preparation of Dye Solutions: Forty milligrams of the acid form of bromcresol purple, produced by the National Aniline Company, were dissolved in 75 c.c. of distilled water, using sufficient 10^{-2} *N* NaOH to bring the *p*H of the solution to 7.25. The volume was then adjusted to 100 c.c. and the *p*H was readjusted to 7.25. This was the standard bromcresol purple solution used in all experiments, from which various dilutions were prepared to give the desired color changes following radiation exposure. In this paper, the various dye concentrations mentioned refer to *v*/*v* dilutions of this stock supply as 100 per cent.

Chloroform: The chloroform used, unless otherwise noted, was Mallinckrodt's Analytical Reagent chloroform. The primary impurity is ethyl alcohol 0.5 per cent, which is added by the manufacturer as a preservative. Washed chloroform or carbon tetrachloride was prepared by shaking the solvent with one-fourth of its volume of 0.01 N NaOH, then with three rinses of distilled water.

Titrations: A stock solution of the 0.01 NaOH was prepared and standardized with potassium acid phthalate. Dilutions to 10^{-3} N and 10^{-4} N were used to titrate the samples. The indicator solution layered over chloroform was shaken after irradiation, allowed to separate, and titrated to its purple end-point. Subsequent shaking and titration were performed until no further color change occurred. In experiments where water-saturated chloroform (not overlayered with water) was irradiated, 0.5 ml. of 4.5 per cent bromcresol purple was added to each 5 c.c. specimen after irradiation. The sample was then shaken and titrated with alkali until subsequent shaking failed to indicate acid in the dye phase.

X-Ray Sources: (*a*) The Picker Industrial Unit, 250 kv., 15 ma., with inherent filtration calculated as 0.21 mm. copper, was used. The source-to-target distance was 35 cm. unless otherwise noted. The containers for the chloroform samples being irradiated were 2-c.c. pyrex volumetric tubes and glass-stoppered weighing bottles of 7 c.c. capacity. All glass stoppers were lubricated with silicone high-vacuum lubricant.

(*b*) The Picker Field Unit, operated at 85 kv., 5 ma., with inherent filtration calculated as equivalent to 0.5 mm. of aluminum, was also used. The source-to-target distance in these experiments was 10 cm., unless otherwise stated. Samples were irradiated in glass-stoppered 2-c.c. volumetric tubes. Because these tubes were used for their convenient shape and size, the 1-c.c. markings were ignored. The 7-c.c. weighing bottles were also used to compare the effect of differences in glass and size of the samples.



Distance and r/hr.

1.20 cm	42.1 r/hr.
1.33	35.8
1.46	30.9
1.65	25.3
1.90	19.8
2.28	14.4
2.88	9.39
4.12	4.76

Fig. 1.—The plastic sample and radium source holder, showing gamma dosage in r/hour.

Gamma Ray Source: The gamma radiation source was obtained from the U. S. Bureau of Standards, with specifications as follows: 9.65 mg. equivalent of radium in a platinum-iridium capsule. The filtration equivalent of the capsule is 0.5 mm. platinum. This source emits gamma rays at the rate of 8.4 r/hr. at 1 cm. per 1 mg. of radium content. For the calculations 10.06 mg. of radium was used because

TABLE I: EFFECT OF VARYING THE RATE OF X-IRRADIATION ON ACID EVOLUTION FROM CHLOROFORM

Dosage in Roentgens	M eq. HCl Evolved	Radiation Rate r/min.	M eq. HCl Evolved	Radiation Rate r/min.
100	0.000013	0.5	0.000012	25.0
150	0.000030	0.5	0.000028	25.0

The target to sample distance at rate of 0.5 r/min. was 245 cm.
The target to sample distance at rate of 25 r/min. was 35 cm.
Samples were 5 c.c. chloroform in 7-c.c. Kimble glass-stoppered weighing bottles sealed with silicone. Samples were titrated as described in text.
X-irradiation factors were 250 kv., 15 ma. and 0.21 mm. Cu, 5 mm. parabolic Cu, 0.6 mm. Pb, and 1.0 mm. Al filtration.
Each value recorded for HCl evolved represents an average of four samples; the deviations from the mean being less than 10 per cent.

the Thuringian glass factor used in the original calibration of the source by the Bureau of Standards had to be considered. A source holder was constructed of plastic in a manner allowing the samples to be placed at specified distances to receive graded doses of gamma radiation. Sample containers used in most of these experiments were the 2-c.c. volumetric glass-stoppered tubes. In Figure 1 the sample and radium source holder is shown. The roentgen values in this figure were calculated by the formula:

$$\text{Roentgens/hour} = \frac{\text{Equiv. mg. Ra.} \times 8.4}{d^2} \times \frac{\tan.^{-1}(L/2d)}{L/2d}$$

This formula is based on the inverse-square law with corrections for the geometry of the sample in relation to the radium source. A similar device was constructed to hold the 7 c.c. weighing bottles and was used to detect differences in acid production related to absorption factors in glass and variations in volume and depth of the chloroform samples.

pH Determinations: Measurement of *p*H was performed by either or both of two methods. Electrometric determinations were made using the Beckman Glass Electrode *p*H Meter, Model G. Colorimetric *p*H determinations were performed using the La Motte Indicator Dye method and equipment. Changes in light transmission of the aqueous dye solutions used were determined on the Beckman Quartz Spectrophotometer, Model Du. This latter instrument was used to measure changes in light transmission of the dye solutions following exposures to large doses of x- and gamma radiation.

SENSITIVITY OF THE TWO-PHASE SYSTEM TO X-RADIATION AND GAMMA RADIATION

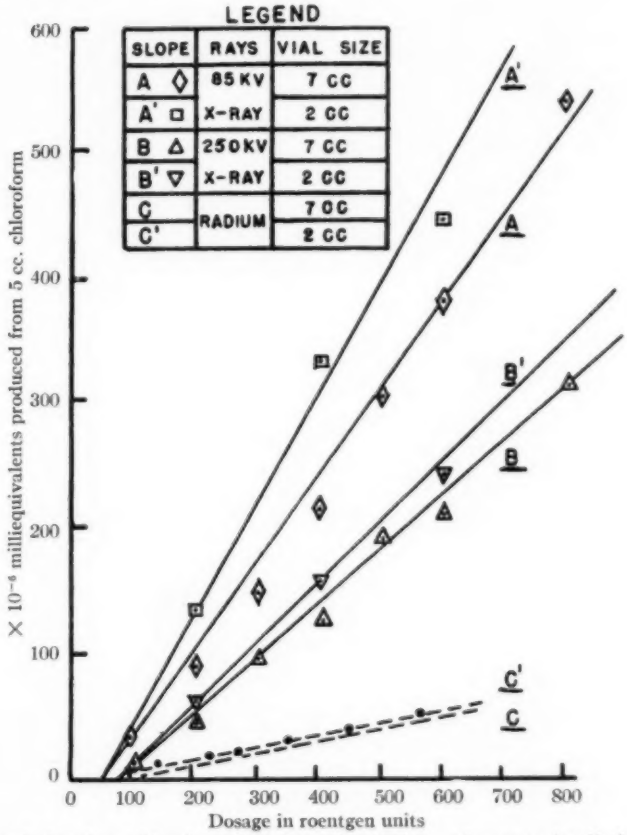
Graph I demonstrates the linear relationship between radiation dosage and titratable acid evolved at 85 kv. and 250 kv. energies. The relative sensitivity of the two-phase system to gamma radiation from the 10-mg. radium source is also demonstrated. There is a similar linear relationship between gamma dosage and acid evolution. The sensitivity to gamma radiation from radium, however, is much lower than to x-radiation from the quarter-million-volt apparatus. The effects of factors of sample size and differences in glass absorption are shown in slopes A′, B′, and C′ compared with slopes A, B, and C respectively. The decreasing effect with more penetrating rays is in accord with established concepts. The most important cause may be the difference in wave lengths. Two other factors may be involved, namely differences in back-scatter and a possible effect from discrepancies in the rate of irradiation, which is approximately 300 times slower with gamma-ray exposure than with x-irradiation.

$$\frac{5 \text{ r/hour}}{1500 \text{ r/hour}} \quad \begin{matrix}\text{(gamma)} \\ \text{(x-ray)}\end{matrix}$$

MAJOR CAUSES OF THE OBSERVED DIFFERENCES IN ACID EVOLUTION FOLLOWING X-RADIATION AND GAMMA RADIATION

Soft glass sample containers gradually liberated small quantities of alkali into

the chloroform. This was initially a factor producing an apparent difference in radiation sensitivity between x-rays and gamma rays, since gamma radiations were administered at a considerably slower rate



Graph I. Acid evolution from chloroform following x-irradiation and gamma irradiation and the effect of glass absorption and sample size with rays of increasing energy.

Radiation factors: X-rays: 85 kv., 5 ma., 3.0 mm. Al filtration, 15 cm. target-object distance. Gamma rays (radium): 0.7 mev (mean), 0.5 mm. Pt, target-object distance as shown in Fig. 1.

Sample containers: 2-c.c. pyrex volumetric tubes and 7-c.c. Kimble glass weighing bottles, both with glass stoppers and sealed with silicone.

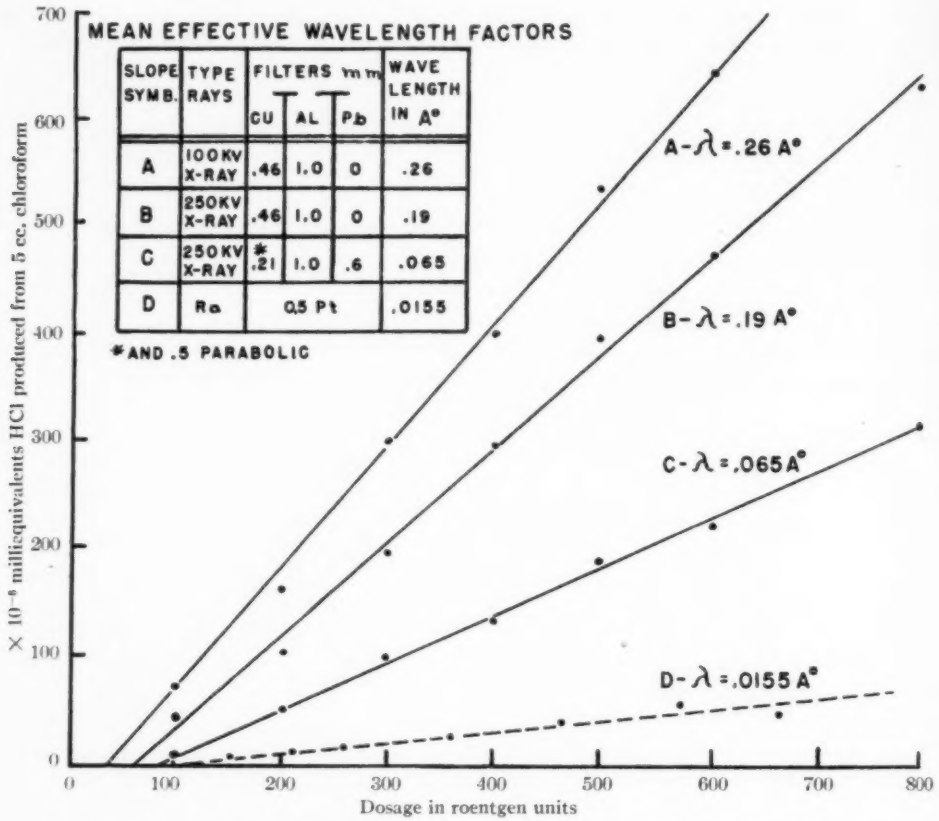
Radiation output at sample sites measured in air with Victoreen r-meter, model 70, and appropriate thimble chambers, depending on dosage rates.

(4.7–42.1 r/hr.) than x-radiations (0.5–100 r/min.).

The effect of wide variations in rate of exposure to x-radiation is shown in Table I. A 50-fold variation at 250 kv., with heavy filtration, produces no significant difference in the quantity of acid liberated from chloroform.

In Graph II the relationship between wave length and acid evolution from chloroform is shown. As wave length is shortened, there is an associated decrease in the quantity of acid evolved. Wavelength variations were produced in the x-ray experiments by altering voltage and changing filtration factors. The almost linear proportion between acid liberated from chloroform per roentgen absorbed and increasing mean effective wave length is shown in Graph III.

The data presented in Graph IV show that as the temperature of chloroform is increased from 5 to 37° C. more acid is


MEAN EFFECTIVE WAVELENGTH FACTORS
SLOPE SYMB. | TYPE RAYS | FILTERS mm CU | AL | Pb | WAVE LENGTH IN A°
A | 100KV X-RAY | .46 | 1.0 | 0 | .26
B | 250KV X-RAY | .46 | 1.0 | 0 | .19
C | 250KV X-RAY | *.21 | 1.0 | .6 | .065
D | Ra | 0.5 Pt | | | .0155
*AND .5 PARABOLIC
A-λ=.26 A°
B-λ=.19 A°
C-λ=.065A°
D-λ=.0155 A°
× 10⁻⁶ millieqivalents HCl produced from 5 cc. chloroform
0
100
200
300
400
500
600
700
800
Dosage in roentgen units

Graph II. Acid production from chloroform following exposure to radium and x-rays with beams of decreasing mean effective wave length.

Mean effective wave lengths shown are equivalents of the wave lengths of monoergic beams, absorbed to the same extent as the heterogenous beams used, by the filtration factors employed. Values determined by method of Duane *et al.*

X-irradiation factors: 250-kv. machine, 15 ma., 0.21 mm. Cu inherent filtration, 35 cm. target-object distance in all experiments. Wave length altered by adding more filters.

Sample containers: 7-c.c. Kimble glass weighing bottles, glass stoppered and sealed with silicone.

produced by x-irradiation. The differences between values obtained at 23 and 37° C. are less than those induced by wave-length dependence (see Graph II).

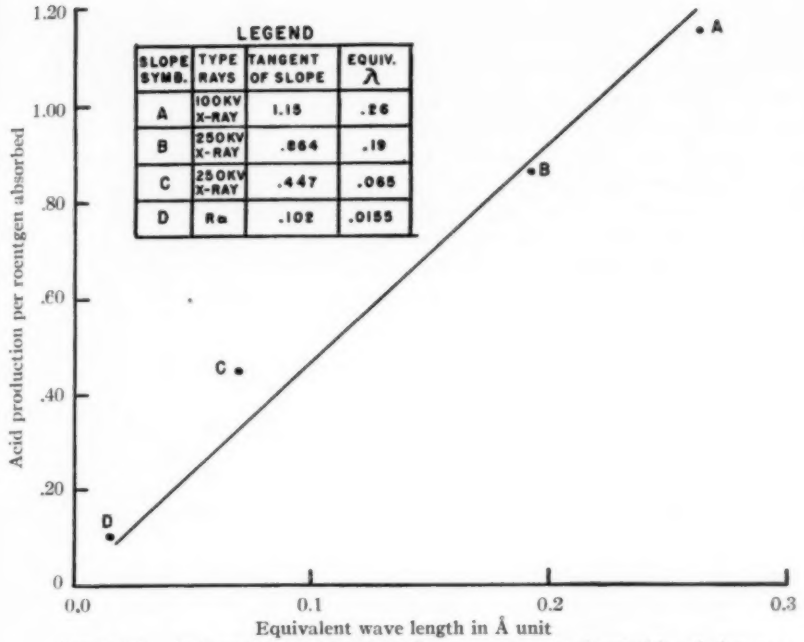
REACTION IN THE TWO-PHASE SYSTEM TO OTHER TYPES OF RADIATION

The two-phase system is relatively insensitive to artificial light, but definite chemical changes are induced in chloroform samples in quartz containers following exposures of forty to sixty minutes to a standard mercury arc ultraviolet lamp.[2] Studies with beta radiation and neutrons have been made, but the sources and technics were inadequate, and results were equivocal. (More complete investigations are being conducted and will be reported later.)

[2] Keese Eng. Co. Model R.E.F.H., 115 volts, 130 watts.

METHODS AND PROCEDURES FOR ADJUSTING THE TWO-PHASE SYSTEM TO MEASURE SPECIFIC RANGES OF RADIATION DOSAGE

Because of the linear proportionality between acid evolution from chloroform and the amount of radiation, in roentgens, absorbed, it is possible to alter the sensitivity of the systems by three methods.



Graph III. Acid production from chloroform per roentgen absorbed in relation to wave length (calculated from the tangent of the slopes in Graph II). Radiation factors, target-object distance, and sample containers as described for Graph II.

First, as the ratio of the amount of chloroform to that of aqueous dye is increased, the sensitivity is enhanced. Secondly, the sensitivity to radiation is decreased in almost direct proportion to an increase in concentration of the dye in the aqueous phase layered over the chloroform. The latter method is preferred for practical reasons. By increasing the dye concentrations, the end-point of the color reaction is made more easily distinguishable. Thirdly, adjusting the *p*H of the aqueous dye to a value near the lower end-point of the indicator increases the sensitivity of the system.

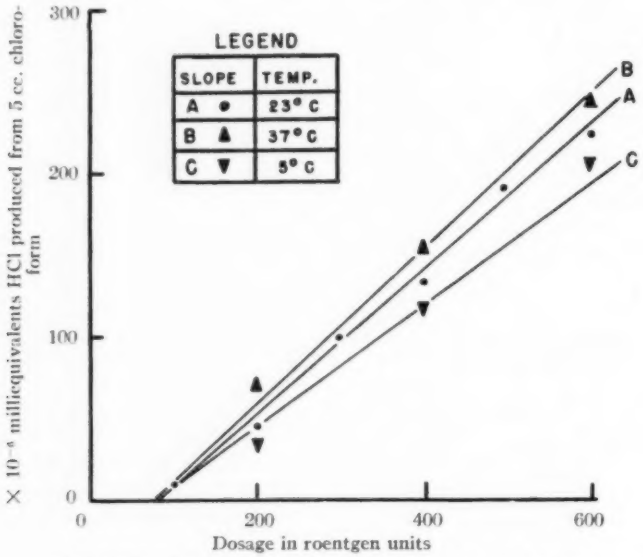
By using relatively high ratios of chloroform to water, such as 15:1, and rather weak concentrations of dye, the system may be adjusted to sensitivity ranges wherein as little as 5 r of x-radiation may be measured. For purposes of personnel casualty monitoring, however, it is advantageous to use strong concentrations of dye with a high ratio of chloroform to aqueous dye phase. In Graph V data are presented which show the variations in radiation sensitivity to x-rays and gamma rays when the ratio between chloroform and water is changed and when the ratio is kept constant but the dye concentrations are altered. The points A and A′ and B and B′ represent the minimum amounts of radiation required to cause a color change in the aqueous dye phase.

SPECIFICATIONS OF THE TWO-PHASE SYSTEM FOR USE IN ATOMIC CASUALTY DOSIMETRY

After exposure to gamma radiation from an atomic bomb air burst emitting gamma rays with an energy ranging between 0.25 and 10 mev, with a mean energy of approximately 3 mev, because of wave-length dependence, only about half as much acid might be evolved in chloroform as would be produced by radiation from a radium source. It is possible, however, that a small amount of neutron and soft gamma radiation might penetrate beyond the 1,000 meter radius; therefore, tentatively, the system has been adjusted

to measure gamma rays with a mean energy similar to that from radium (0.7 mev). Additional investigation may probably require revision of this estimate and adjustment for measuring the three ranges of gamma dosage specified for atomic bomb casualty and area monitoring.

General Specifications: The chemical reagents, chloroform, pure water, and aqueous bromcresol purple (acid form), should all be of the highest chemical purity. The



Graph IV. Effect of chloroform temperature during x-irradiation on acid production.

Radiation factors: 250 kv.; 15 ma.; 0.21 mm. Cu inherent filtration, 0.5 mm. Cu parabolic, 0.6 mm. Pb, and 1.0 mm. Al filtration, target-object distance 35 cm.

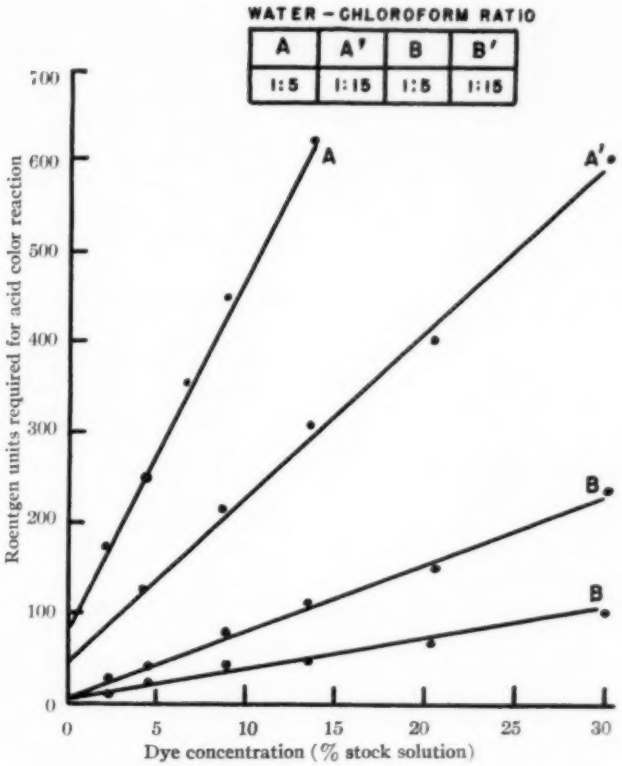
Sample containers: 7-c.c. Kimble glass weighing bottles with glass stoppers, sealed with silicone.

Temperature of the chloroform samples was regulated by partially submerging the bottle in a shallow constant temperature water bath.

may be suitable. Thick-walled pyrex glass capillary tubes may be cut and sealed in proper sizes for use as sample containers in small personnel casualty badges. The sample container must be protected from ultraviolet light and from soft rays by suitable shielding.

Recommended Reagents: Their Proportions and Concentrations: A 15:1 ratio of chloroform to aqueous dye has been found satisfactory to measure radiation throughout the range between 200 and 600 r of gamma radiation; 1.5 c.c. of chloroform, plus 0.1 c.c. of a 9.0 per cent aqueous bromcresol purple dye solution is added to a 2 c.c. volumetric glass-stoppered tube. With this ratio and dye concentration, reaction occurs at approximately 200 r of gamma radiation (radium source), the color changing from purple to yellow. To measure radiation at values of approximately 400 r, the same ratio

containers for the mixture should not react to the reagents in any way and should not contain acid or alkaline material. Pyrex glass 2-c.c. volumetric tubes with ground-glass stoppers, sealed with silicone around the stopper and protected on the outside with plastic tape or sealing wax, make satisfactory primary containers for an area monitoring device. Soft glass should not be used because it liberates alkali. A few polyethylene-type plastics



Graph V. Effect of varying water-chloroform ratios and dye concentrations on sensitivity of color reaction to x-radiation and gamma radiation.

Radiation factors: Slopes B and B′: X-rays at 85 kv., 5 ma., 3.0 mm. Al filtration, target-object distance 15 cm. Slopes A and A′: Gamma rays (radium) with 0.5 mm. Pt filtration, target-object distance and position as shown in Fig. 1.

Sample containers: 2-ml. glass-stoppered pyrex volumetric tubes sealed with silicone. These were placed horizontally and irradiated with x-rays from above.

The *p*H values of the various concentrations of dye, prior to irradiation were: 2.25 per cent, *p*H 6.6; 4.5 per cent, *p*H 6.8; 9.0 per cent, *p*H 6.88; 13 per cent, *p*H 6.95; 20.0 per cent, *p*H 7.1; 30.0 per cent, *p*H 7.2.

The stock solution of dye contains 40 mg. bromcresol purple per 100 c.c.

but with 20.0 per cent aqueous dye is used; for the measurement of 600 r, the same ratio with 30.0 per cent dye. By preparing three tubes, containing 1.5 c.c. of chloroform and 0.1 c.c. of aqueous bromcresol purple in the three concentrations specified, it is possible to measure the dosage ranges of gamma radiation which correspond to the three groups of individuals in an atomic catastrophe, previously discussed. Figures 2 and 3 are photographs of three possible types of casualty dosimeters before and after irradiation.

The colorimetric dosimeter containing three tubes of the above mixture plus color standards of the dye, worn on a person exposed to 200 r of 0.7 mev gamma radiation, would show a change in the first tube from purple to yellow, but the second and third tubes would remain purple. After exposure to more than 600 r, all tubes would turn yellow or color-

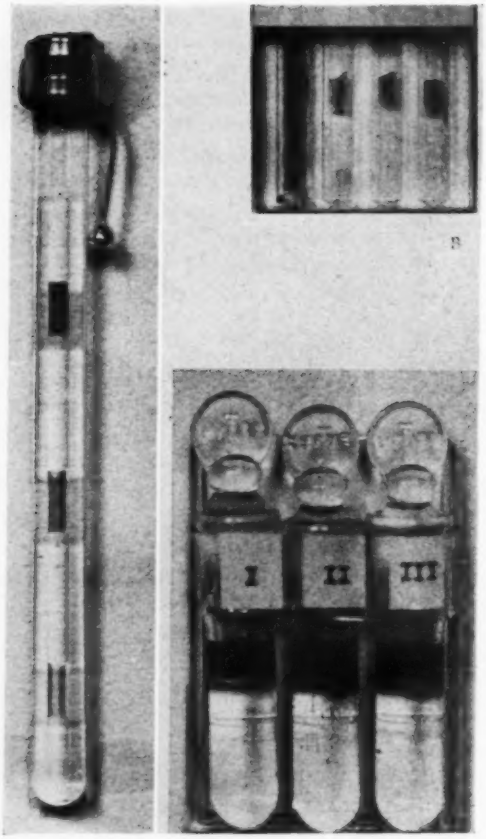


Fig. 2. Three types of casualty dosimeters, before exposure to radiation. Left: Pencil type. Upper right: Dog-tag type personnel casualty badge. Lower right: Area monitoring dosimeter.

less. With intermediate dosage, as for example 350 r, the first tube would be yellow, the second tube a faint violet or light gray, and the third tube purple. If the instrument were irradiated with approximately 150 r, the first tube would be light gray or violet and the second and third tubes purple.

DISCUSSION

If somewhat higher energy gamma radiation (3 mev average) plus a small amount of neutron and soft gamma radiation (0.25–0.5 mev) produce effects in chloroform similar to gamma rays from radium, this method of measurement may be sufficiently accurate to be of distinct value in classifying persons with radiation injury into three groups. Further investigation is needed to discover factors which may alter its accuracy. In particular, it is important to determine the reactions of the system to neutron radiation and to higher-energy x-rays and gamma rays. Also, its reactions to mixed radiations of different types and

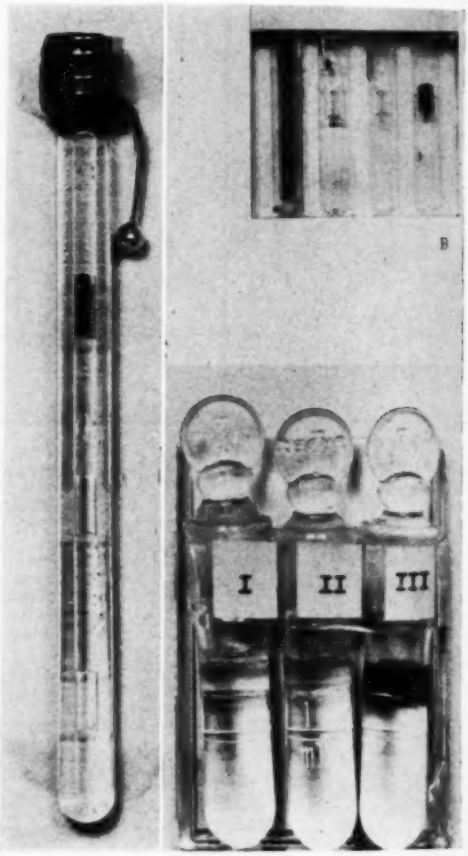


Fig. 3. Three types of casualty dosimeters after exposure to radiation. Left: Pencil type. Upper right: Dog-tag type personnel casualty badge. Lower right: Area monitoring dosimeter.

wave lengths should be investigated. Furthermore, it should be given simulated practice trial under widely varying climatic conditions.

These studies have demonstrated a wave-length dependence of chloroform

with x- and gamma irradiation which may be interpreted to mean that less specific ionization and/or chemical activation is produced by high-energy rays than by soft rays of longer wave length (39, 40). This has been demonstrated by finding less acid formed in chloroform by gamma radiation (0.7 mev average energy from the radium source) (41) than by 250-kv. x-radiation even when heavy filtration is used (copper, aluminum, and lead). See Graphs I and II.

In further studies it is planned to measure the acid evolution from chloroform after exposure to higher energy x-ray and gamma-ray sources. Such measurements, in conjunction with animal experiments, are necessary to make more accurate estimates of gamma dosage and energy ranges at which the reacting system should be adjusted for use in personnel casualty badges or area dosimeters. More information regarding the relative biological effects from LD50 doses of very high energy x-radiation or gamma radiation, compared with lower energy levels, is needed. Biological data of this type would permit better estimation of maximum human tolerance values to highly penetrating radiation received in short, single, or fractional exposures.

It is possible that there is a measurable relationship between chemical effects in a simple organic mixture (water-saturated chloroform) and biochemical reactions induced in the tissues of animals by penetrating radiations. A similar difference in relation to variation in wave length may exist. Some supporting evidence has been published by others wherein it is recorded that the LD50 doses from one-million-volt x-rays and gamma radiation from radium are significantly higher than the doses required, in animals and man, when 200-kv. x-rays are used (19, 42).

The dose of radiation necessary to produce a threshold erythema increases as the mean effective wave length is decreased (42, 43). This skin reaction correlates with specific ionization. Furthermore, a greater biologic effect is induced by neutron radiation than by x-rays or gamma rays in equivalent doses in roentgens, measured in air (39, 43, 44). Also, it is common knowledge among radiologists that a greater dose of gamma radiation (radium) is required to produce a specific biological effect than of 200-kv. filtered x-rays (45).

Some of the discrepancies in the literature are due in part to variations in instruments and their standardization, as well as differences in radiation factors, biological variations, and radiation susceptibility deviations known to exist in different colonies of the same animal species.

Chemical and physical methods of radiation dosimetry conducted in conjunction with biological experiments may give valuable information regarding a possible relation between chemical and biological effects induced by penetrating rays of different energy and specified ionization (46, 47). There may be a correlation between the amount of acid liberated by radiating water-saturated chloroform and tissue damage in man or animals, especially in respect to wave-length dependence. The interpretation of measurable biological effects of penetrating radiation must include consideration of wave-length variables, back-scatter, per cent depth dose, animal size, target-to-object distance, and field size and shape, taking into account, also, the rate of irradiation and its relation to biological recovery factors (40, 43).

SUMMARY AND CONCLUSIONS

A chemical method for estimating penetrating x-radiation and gamma radiation colorimetrically has been developed. Its basic principle is the linear proportionality between acid evolution in water-saturated chloroform and the quantity of radiation energy transmitted. The acid liberation reduces the *p*H of the aqueous phase, containing the indicator bromcresol purple, which turns from purple at *p*H 6.8 to yellow at *p*H 5.2. By using a two-phase system, chloroform overlayered with the aqueous dye in the ratio of 15 parts chloro-

form to 1 part water, and concentrations of dye varying between 9.0 and 30.0 per cent, it is possible to measure three ranges of gamma dosage (radium source).

A 9.0 per cent concentration of dye, overlayered on chloroform, changes color completely at approximately 200 r ± 50 r. A 20.0 per cent dye chloroform system reacts with the same color change at approximately 400 r. A 30.0 per cent dye mixture turns yellow at approximately 600 r.

The reaction shows a wave-length dependence, especially with relatively soft x-rays, but is not altered by changes in the rate of irradiation between the limits studied (0.5–25 r/min.). The system is also affected by temperature variations, more acid being produced at body temperature than at near-freezing values. These findings may have some biological significance. They provide evidence to support the chemical theories of the mechanism of action of radiations in aqueous systems. More investigations are needed to determine the possible differences in biological effects produced by penetrating radiation of high energy compared with wave lengths that have been used routinely.

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Atomic Energy Project
P. O. Box 4164
West Los Angeles 24, Calif.

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SUMARIO

Dosímetro Colorimétrico para la Medición Cualitativa de las Radiaciones Penetrantes

El requisito primordial de un aparato de despistaje para empleo por el personal en una explosión atómica es que mida rayos gamma de altos valores de energía (aproximadamente 0.25 a 10 mev) en tres escalas de dosis, 0–200, 200–400, y 400–600 r, que producen efectos cada vez más graves.

Un método químico para descubrir rayos X y rayos gamma correspondientes a dichas escalas ha sido descubierto. Básase en el principio de que, en cloroformo saturado con agua, se forma ácido en proporción lineal a la cantidad de radiación absorbida. El ácido producido y la exposición a la irradiación se miden colorimetricamente con un colorante indicador (púrpura de bromcresol) en solución acuosa formando una capa sobre cloroformo. Inmediatamente después de agitar, se lava a la fase acuosa el ácido formado en el cloroformo, ocasionando un cambio de color claramente visible si se ha recibido la dosis de irradiación predeterminada.

Una concentración de 9.0 por ciento de colorante, sobrepuesta a cloroformo, cambia completamente de color a unos 200 r ± 50 r. Una combinación de 20.0 por ciento de colorante-cloroformo reacciona con el mismo cambio de color a unos 400 r. Una mezcla de 30.0 por ciento de colorante se vuelve amarilla a unos 600 r.

La reacción muestra una relación con el largo de onda, máxime con rayos X relativamente blandos, pero no la alteran los cambios de velocidad de la irradiación entre los límites estudiados (0.5–25 r/min.). También afectan el método las variaciones térmicas, produciéndose más ácido a la temperatura del cuerpo que a cifras próximas a la congelación.

EDITORIAL

The Evaluation of Personal Radiation Exposure

Ever since it was realized, half a century ago, that the use of x-rays and rays from radioactive substances involved a personal hazard, efforts have been made to limit exposure in order to minimize the dangers. To this end, various devices have been developed to determine just what exposures existed, for various places or persons.

There have long been two aspects of the problem. The first is that of the doctor or technician who receives small doses daily, over long periods of time. These may seem entirely innocuous, but after years of such exposure, deleterious effects may become manifest. The second is that of the patient, who for diagnostic purposes is subjected to radiography and fluoroscopy to such a degree that acute or chronic radiation changes may be produced. (The patient who receives too much radiation therapy might also be included in this category.) To these two types of hazard, we must now add the problems engendered by the possibility of atomic warfare.

Let us dispose promptly of the second of the above categories by pointing out that, with suitable calibration of equipment, and an understanding of the dangers on the part of those using it, this problem should disappear. At present, damage from excessive fluoroscopy is seldom seen in properly organized departments of radiology; it is much more likely to occur with nonradiologists using fluoroscopes to look for foreign bodies, set fractures, or demonstrate abnormal conditions. It may be that an educational campaign is needed here; it is not likely that any monitoring device will be of much use.

With regard to the group who might receive chronic low-intensity exposures, the practice for a long time was to rely on a careful survey of the department, either with a large ionization chamber, or with dental films, or both, and then to expect that no person would go into areas not known to be safe. However, because a direct check was preferable to an indirect one, the use of dental film was extended to its being worn as a badge for some set period of time by anyone who was concerned about exposure. The film was then developed, and the dose of radiation received was evaluated by comparison with films exposed to known fractions or multiples of a roentgen.

With the rapidly increasing use of artificially radioactive isotopes the individual badge has become a very important supplement to the over-all survey. Instead of the simple dental film with a paper clip across it to cast a shadow, special holders have been devised which contain two or three filters, so that the quality as well as the quantity of the radiation can be determined. Various commercial concerns, as well as the Atomic Energy Commission, offer a reliable film badge service, sending fresh films at stated intervals, receiving, developing, and measuring the exposed ones. The ultimate in such badges appears to be now in sight, with a self-developing film which can be opened and examined at any time. The film packet contains also a previously developed strip which has already had a calibrated series of exposures, so that an immediate evaluation is possible.

The great difficulty with ordinary films was the need for development and measurement, with the resulting impracticability of making spot checks on personal exposure. For this purpose, therefore, small "monitor" condenser ionization chambers

were developed, about the size and shape of a fountain pen. These must be charged in a device made for the purpose; the earlier ones could be read only by means of a specially constructed electrometer. More recently some have been produced with the electrometer connected directly to the ionization chamber and contained in the same case. After being charged, these can be read at any time; thus the exposure during any interval can be determined. Unless the instrument has been completely discharged by the exposure, it is not necessary to recharge it for a subsequent interval, but only to note the reading at the beginning of the period. Since these instruments are used primarily for checking the protection of personnel believed not to be having any significant irradiation, determinations are usually in milliroentgens per interval, or in total milliroentgens. Since relatively few people are involved, the cost of the equipment has not been a very serious consideration. Thus the safeguarding of the medical and technical group has become reasonably well assured.

With the possibility of atomic warfare, the problems that arise are of a different order of magnitude. We shall want to be able to know the total doses delivered at the time of an atomic bomb explosion to all within range of the radiations, and this means the evaluation of doses up to many hundreds of roentgens, for large numbers of people. Following the explosion, we shall need to know radiation dosage rates in contaminated areas, in order to determine the length of time it will be safe for emergency workers to remain there, or, later, to decide when to return the people to their homes or places of business.

Thus we will need, first, inexpensive, rugged, and reliable *dose meters, indicating total doses* with a range of say from 25 r to 750 r, which can be widely distributed, to thousands of individuals, worn or carried without inconvenience, or posted in many buildings, and which will remain effective for considerable periods without servicing. These must be instruments or devices which can be quickly read by civilian defense radiation surveyors with an accuracy of ± 25 per cent or better. The above-mentioned self-developing films are too sensitive for the higher doses. Ionization instruments of any conventional type require regular charging and frequent checking, and are in general too expensive for widespread distribution. Various experiments being carried out with crystals or liquids that change color on exposure to radiation are of promise here. It is also to be expected that some type of simple, rugged, and inexpensive ionization device will be developed, which can be readily charged at will by the user.

For determining the degree of contamination subsequent to the blast, we shall need *dosage rate meters* indicating intensities of say from 1 to 500 r per hour. These must be rugged, light enough to be easily carried by the radiation area surveyor on foot, simple to service, easy to read, and inexpensive enough to be distributed by hundreds in all potential bombing targets. Such instruments are being developed by various companies, and it is expected that the need will be met.

Radiologists were the first group to recognize and attempt to evaluate radiation dangers. They have continually urged development of better monitoring apparatus. Within their special field, they have long been insistent on the use of every available means to insure adequate protection, and in this respect they have set a high standard of achievement. In recent years they have carried their safety campaign to industrial users of x-rays and radioactive materials. Now, faced by a great civilian emergency, it is to be expected that they will be equally zealous to keep in touch with all new developments and to assist in employing them to the best advantage in this crucial field.

EDITH H. QUIMBY, Sc.D.

ANNOUNCEMENTS AND BOOK REVIEWS

ROCHESTER ROENTGEN RAY SOCIETY

At the annual meeting of the Rochester (N. Y.) Roentgen Ray Society in December 1950, the following officers were elected: Dr. Ralph E. Alexander, President; Dr. A. Vaughn Winchell, Vice-President; Dr. George Gamsu, 191 S. Goodman St., Rochester, Secretary-Treasurer. The Society meets on the last Monday of each month, September through May, at Strong Memorial Hospital

ST. LOUIS SOCIETY OF RADIOLOGISTS

The newly elected officers of the St. Louis Society of Radiologists are: President, Dr. Hugh M. Wilson; Vice-President, Dr. Hyman R. Senturia; Secretary-Treasurer, Dr. Donald S. Bottom, 510 South Kingshighway Blvd., St. Louis 10.

OHIO STATE RADIOLOGICAL SOCIETY ANNUAL MEETING

The annual meeting of the Ohio State Radiological Society will be held May 25–27, in the Fort Hayes Hotel, Columbus. The program is as follows:

Friday, May 25

Golf in afternoon; dinner at the Country Club

Saturday, May 26

9:00 A.M. Urologic Problems in Pediatric Diagnosis, Dr. Fred Silverman.

9:30 Abdominal Aortography, Dr. Benjamin Felson and Dr. Arthur Evans.

10:30 Fluoroscopy in Conjunction with Retrograde Pyelography, Dr. E. C. Baker and Dr. F. A. Miller.

11:00 Visualization of the Intervertebral Disk with Diodrast, Dr. Robert Wise.

12:00 Luncheon and Business Meeting

2:00 P.M. Carcinoma of the Cervix as Studied at the Cincinnati General Hospital for the Past Eleven Years—Complications, Treatment, and Results, Dr. Charles Barrett.

2:45 Contact Therapy in Superficial Lesions, Dr. Robert A. Hays.

7:30 Dinner, Entertainment, Dancing

Sunday, May 27

10:00 A.M. Stump the Experts: Diagnosis. Moderator, Dr. Clarence Hufford. Panel: Dr. Benjamin Felson, Dr. John R. Hannan, Dr. Joseph L. Morton, Dr. James G. Tye.

12:00 Luncheon and Business Meeting

2:00 P.M. Information Please: Therapy. Moderator, Dr. Robert A. Hays, Panel: Dr. Charles Barrett, Dr. Harry Hauser, Dr. Edward T. Kirkendall, Dr. W. S. Pick.

AMERICAN SOCIETY OF X-RAY TECHNICIANS

The Twenty-third Annual Convention of the American Society of X-Ray Technicians will be held June 3–8, 1951, in the Benjamin Franklin Hotel, Philadelphia, Penna. Harry Y. Ball, R.T., Bryn Mawr Hospital, Bryn Mawr, Penna., is the General Chairman.

AMERICAN COLLEGE OF CHEST PHYSICIANS

The Seventeenth Annual Meeting of the American College of Chest Physicians will be held at the Ambassador Hotel, Atlantic City, N. J., June 7–10, 1951. The Board of Examiners of the College has announced that the next oral and written examinations for Fellowship will be held in Atlantic City on June 7. Candidates who would like to take the examinations for Fellowship should contact the Executive Secretary, American College of Chest Physicians, 500 North Dearborn St., Chicago 10, Ill.

The Convocation ceremonies will be held on Saturday, June 9, at which time Certificates will be awarded to new Fellows of the College. An x-ray conference conducted by Dr. Leo G. Rigler, Minneapolis, will be presented on Saturday afternoon. All physicians are invited to attend.

JOSEPH FREEDMAN LECTURES UNIVERSITY OF CINCINNATI

On Saturday and Sunday, April 28 and 29, 1951, Dr. Edward B. D. Neuhauser, of Children's Hospital, Boston, will deliver the third annual Joseph Freedman Lectures in Diagnostic Roentgenology at the University of Cincinnati College of Medicine.

ERRATUM

In checking the tables in the paper on "The Use of Photographic Films for Monitoring Stray X-rays and Gamma Rays," by R. B. Wilsey, in Radiology for February 1951, the author has discovered an unfortunate error. In Table II, on page 232, the numerical value 0.02 in the second line of Column 5 (headed 2) should be 0.2. This is the value for

Kodak Super-Speed Occlusal Dental X-Ray Film (Code DF-45).

REPORT OF JOINT COMMITTEE ON CHEST X-RAY

The following report was prepared by a joint committee representing the American College of Chest Physicians and the American College of Radiology, meeting in San Francisco, June 25, 1950. It was approved by the Board of Regents of the American College of Chest Physicians on Dec. 4, 1950, and by the Board of Chancellors of the American College of Radiology on Feb. 7, 1951.

Members of the Committee of the American College of Radiology were:

Leo G. Rigler, M.D., Minneapolis, Minn., Chairman
Sydney J. Hawley, M.D., Seattle, Wash.
Russell H. Morgan, M.D., Baltimore, Md.
E. P. Pendergrass, M.D., Philadelphia, Penna.
Paul C. Swenson, M. D., Philadelphia, Penna.

Members of the Committee of the American College of Chest Physicians were:

Otto L. Bettag, M.D., Chicago, Ill., Chairman
Robert J. Anderson, M.D., Washington, D. C.
Hollis E. Johnson, M.D., Nashville, Tenn.
Edward Kupka, M.D., Berkeley, Calif.
James H. Stygall, M.D., Indianapolis, Ind.

It is hoped that this report of two organizations concerned with mass chest x-ray surveys and routine chest x-ray examinations in general hospitals will clarify any controversial problems regarding these procedures. It is also hoped that the broad principles upon which this report has been formulated may serve as a basis for solving any local situations which may arise concerning mass chest x-ray programs or routine chest x-ray in general hospitals.

Purpose of Joint Committee on Chest X-ray

The purpose in having a Joint Committee on Chest X-ray is that two professional organizations, who have common interests, may exchange ideas and formulate unified thinking on the problems involved in routine chest x-rays in hospitals (general, mental, etc.) and mass chest x-ray programs. In addition to this the Committee, after considerable discussion, agreed to another point, namely: that each physician should be encouraged to have a chest x-ray on all of his patients.

Limits of Survey

For purposes of this discussion routine chest survey examinations should be defined as those examinations of the chest which are conducted on microfilm apparatus for screening normal persons from those patients with abnormal changes in the chest. The examinations are screening and are not to be considered as diagnostic procedures. Screening method is for the purpose of detecting the presence or absence of a lesion but should not be utilized for identifying the nature of the pathological process.

The 14 × 17-inch film is fundamentally a diagnostic tool and its use, therefore, makes the examination more than a screening procedure. Survey chest x-rays, either in hospitals or in general population, are approved as a screening device if conducted by agencies which utilize well qualified professional technical staffs and which make a sincere effort to send the positive individuals to qualified local physicians or clinics for proper follow-up. The methods of conducting these were discussed at length. These included surveys by the U. S. Public Health Service, etc. Dr. Newell reported on the San Francisco County Medical Society's plan, whereby the medical society is responsible for the surveys but the project is financed through the local tuberculosis association.

Interpretation and Report

Interpretation and reporting of medical findings is a medical matter and should bear the signature or identification of the responsible physician.

Method of reporting of chest survey studies: This is a local matter and is by prearranged agreement between the employer and the employee in industrial surveys; in other surveys it is in accord with medical ethics, according to local agreement.

Type of reporting: The Committee discourages the reporting of suspicious cases as tuberculosis. It believes this to be a clinical diagnosis. The x-ray interpreter should designate the cases that require immediate follow-up as "urgent." The small film x-ray interpretation is merely an impression.

It should be emphasized that the 14 × 17-inch film is a diagnostic aid and the results derived therefrom are also impressions and not diagnoses. Even the larger film is but one of several examinations necessary in order to establish correct diagnoses.

Professional Compensation

Professional cost of performing routine chest examinations in hospitals: The Joint Committee believes the radiologist and/or chest physician should be compensated just as any other physician practising his profession. The procedure is time-consuming and places a definite responsibility on the radiologist or chest physician. The Committee likewise felt that in this matter the basic principle of payment is by arrangement between the physician and the hospital or agency involved. In the reading of follow-up films there should also be an individual limit to the number of films which should be read in any one day by one physician and which he should not exceed. The compensation, of course, would have to take into consideration whether the physician not only reads the film but also makes the film.

Clothing of Patients

Whether or not a screening examination can be conducted with the patient fully clothed: Since the number of lesions overlooked because of clothing (2%) is considerably smaller than the normal variations of interpretation Chamberlain, etc., have demonstrated to exist in the reading of photofluorographic films, it was concluded that the examination of clothed persons was as effective a procedure as examination of undressed persons. Since examination of the fully clothed persons is an easier procedure as compared with the examination of the undressed persons, the Committee agreed that screening examination can be conducted with the patient fully clothed.

Readers' Qualifications

Qualifications of readers in mass chest surveys: It was believed that at the present time there was no practical method which could be used to evaluate the qualifications of a particular reader. Studies in this respect are being made at the present time. It is hoped that within a short period of time satisfactory testing methods will be available. The Committee therefore agreed to leave this matter open for further discussion.

Conclusion

The two Committees agreed that the bi-committee arrangement should continue and that another meeting be arranged in at least one year. In an effort to have the committees act continuously and without interruption, interim ideas should be sent to the respective chairmen and an exchange of opinions should continue during the meeting interval.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

A MANUAL OF ARTIFICIAL RADIOISOTOPE THERAPY. Edited by PAUL F. HAHN, Cancer Research Laboratories, Meharry Medical College, Nashville, Tenn. A volume of 310 pages, with numerous illustrations and tables. Published by the Academic Press Inc., New York, 1951. Price $6.80.

MALIGNANT DISEASE OF THE FEMALE GENITAL TRACT. By STANLEY WAY, M.R.C.O.G., Gynaecologist to the Newcastle Regional Cancer Organization; Associate Surgeon, Gynaecological Department, Royal Victoria Infirmary, Newcastle-on-Tyne; Hunterian Professor, Royal College of Surgeons of England, 1948; Blair Bell Lecturer, Royal College of Obstetricians and Gynaecologists, 1948. A volume of 280 pages, with 38 illustrations. Published by The Blakiston Co., Philadelphia, 1951. Price $5.00.

THERAPEUTIC RADIOLOGY. By GEORGE WINSLOW HOLMES, M.D., Radiologist, Waldo County General Hospital, Maine; Honorary Physician, Massachusetts General Hospital; Radiologist-in-Chief, Massachusetts General Hospital, 1916–1941; Clinical Professor of Roentgenology, Emeritus, Harvard Medical School, and MILFORD D. SCHULZ, M.D., Radiologist, Massachusetts General Hospital; Instructor in Radiology, Harvard Medical School. A volume of 348 pages, with 121 illustrations, 10 in color. Published by Lea & Febiger, Philadelphia, 1950. Price $7.50.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6, Ill.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. D. Anderson, M.D., 420 10th St., Tuscaloosa.

Arizona

ARIZONA ASSOCIATION OF PATHOLOGISTS AND RADIOLOGISTS. *Secretary*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Sydney F. Thomas, M.D., Palo Alto Clinic, Palo Alto.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADICLOGICAL SOCIETY. *Secretary*, Harold P. Tompkins, M.D., 658 South Westlake Ave. Meets monthly, second Wednesday, County Society Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, Clifford W. Wauters, 701 High St., Auburn. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually with State Medical Association.

SAN DIEGO ROENTGEN SOCIETY. *Secretary*, R. F. Niehaus, M.D., 1831 Fourth Ave., San Diego. Meets first Wednesday of each month.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Merrell A. Sisson, M.D., 450 Sutter St., San Francisco 8. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Paul E. RePass, M.D., 306 Republic Bldg., Denver 2. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meetings bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Ellwood W. Godfrey, M.D., 1676 Boulevard, W. Hartford. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Karl C. Corley, M.D., 1835 Eye St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Auditorium.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Thos. H. Lipscomb, M.D., 30 West Beaver St., Jacksonville, 2. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Theodore M. Berman, M.D., 350 Lincoln Road, Miami Beach. Meets monthly, last Wednesday, 8:00 P.M., in the Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Dudley King, M.D., 35 Linden Ave., N. E. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert C. Pendergrass, M.D., Americus. Meets in November and at the annual meeting of State Medical Association.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Benjamin D. Braun, M.D., 6 N. Michigan Ave., Chicago 11. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly as announced.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Willard C. Smullen, M.D., St. Mary's Hospital, Decatur.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, William M. Loehr, M.D., 712 Hume-Mansur Bldg., Indianapolis 4. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*, Arthur W. Erskine, M.D., 326 Higley Building, Cedar Rapids. Meets during annual session of State Medical Society

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Anthony F. Rossitto, M.D., Wichita Hospital, Wichita. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY, *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel.

Louisiana

LOUISIANA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Johnson R. Anderson, M.D., No. Louisiana Sanitarium, Shreveport. Meets with State Medical Society.

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB, *Secretary*, Oscar O. Jones, M.D., 2622 Greenwood Road. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston.

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BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary*, J. Howard Franz, M.D., 1127 St. Paul St., Baltimore 2.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M.D., Harper Hospital, Detroit 1. Meetings first Thursday, October to May, at Wayne County Medical Society club rooms.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS. *Secretary-Treasurer*, R. B. MacDuff, M.D., 220 Genesee Bank Building, Flint 3.

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Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Wm. M. Kitchen, M.D., 1010 Rialto Building, Kansas City 6, Mo. Meetings last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Donald S. Bottom, M.D., 510 S. Kingshighway Blvd. Meets on fourth Wednesday, October to May.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Russell W. Blanchard, M.D., 1216 Medical Arts Bldg., Omaha. Meets fourth Thursday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, L. L. Robbins, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday at the Harvard Club.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., Elliot Community Hospital, Keene. Meetings quarterly in Concord.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Peter J. Gianquinto, M.D., 685 High St., Newark 2. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

ASSOCIATED RADIOLOGISTS OF NEW YORK, INC. *Secretary*, William J. Francis, M.D., East Rockaway.

BROOKLYN ROENTGEN RAY SOCIETY. *Secretary*, J. Daversa, M.D., 603 Fourth Ave., Brooklyn. Meets fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meetings second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 10. Meetings January, May, October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meetings fourth Thursday evening, October to May, at 8:45 P.M., Kings County Medical Bldg

NEW YORK ROENTGEN SOCIETY. *Secretary*, John L. Olpp, M.D., 49 Ivy Lane, Tenafly, N. J.

QUEENS ROENTGEN RAY SOCIETY. *Secretary*, Jacob E. Goldstein, M.D., 88–29 163rd St., Jamaica 3. Meets fourth Monday of each month.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, George Gamsu, M.D., 191 S. Goodman St. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, James E. Hemphill, M.D., Professional Bldg., Charlotte 2. Meets in May and October.

North Dakota

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Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Edward C. Elsey, M.D., 927 Carew Tower, Cincinnati 2. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Hannan, M.D., 10515 Carnegie Ave., Cleveland 6. Meetings at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary*, Lawrence Gibboney, M.D., Carew Tower Bldg. Meets first Monday, September to May.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

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Oregon

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Pacific Northwest

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Pennsylvania

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PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 8:00 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St.

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Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., Lincoln Clinic, Lincoln, Nebr. Next annual meeting, Aug. 9–11, 1951, Denver.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, S. H. Fisher, M.D., 107 E. North St., Greenville. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets with State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, X. R. Hyde, M.D., Medical Arts Bldg., Fort Worth 2. Meets monthly third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Frank M. Windrow, M.D., 1205 Hermann Professional Bldg., Houston 5

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting, Jan. 18–19, 1952, Houston.

Utah

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Virginia

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Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. C. Kiltz, M.D., 705 Medical-Dental Bldg., Everett. Meetings fourth Monday, October through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Theodore J. Pfeffer, M.D., 839 N. Marshall St., Milwaukee 2. Meets monthly on second Monday at the University Club.

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UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursdays 4 P.M., September to May, Service Memorial Institute, Madison 6.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542, Santurce, Puerto Rico.

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LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, México, D. F. Meetings first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama. R. de P.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Radiological Assessment of the Normal Aqueduct and 4th Ventricle. David Sutton. Brit. J. Radiol. **23:** 208–218, April 1950.

For the purpose of confirming and extending previous observations, an examination of the aqueduct and fourth ventricle was made on 100 normal subjects, all by air encephalography.

After a description of the anatomy, a discussion of different methods of examination, and an account of the roentgen anatomy, the methods of measurement and evaluation employed in the present study are described.

It was found that (1) the distance from the dorsum sellae to the aqueduct was 2.9 to 4.1 cm.; (2) from the dorsum sellae to the floor of the fourth ventricle 3.1 to 4.3 cm.; (3) the height of the fourth ventricle 1.3 to 2.1 cm.; (4) the distance from the fastigium to the mouth of the aqueduct 3.4 to 5.1 cm.; (5) the ventricular angle 85 to 95 degrees. These measurements are useful in evaluating minimal departures from the normal.

Fourteen illustrations, including 9 roentgenograms; 4 graphs. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Craniopharyngiomas (Pituitary Adamantinomas). J. Grafton Love and Thomas M. Marshall. Surg., Gynec. & Obst. **90:** 591–601, May 1950.

One hundred cases of craniopharyngioma, or pituitary adamantinoma, are reviewed, with reference to embryologic development, pathologic features, clinical and diagnostic aspects, and roentgen and surgical treatment.

Pituitary adamantinomas constitute approximately 4 per cent of all intracranial neoplasms and about 30 per cent of all pituitary tumors. In the authors' series a larger number were seen in the second decade of life than in any other ten-year period, but 47 per cent of the patients were more than twenty years of age. Headache and loss of vision were by far the most common symptoms, followed by endocrine disturbances, vomiting, drowsiness, and signs of involvement of the neighboring structures.

Roentgenologically, adamantinomas produce changes which are characteristic of both extrasellar and intrasellar tumors. Extrasellar changes indicative of increased intracranial pressure were observed in 23 cases. The outline of the sella turcica was abnormal in 63 cases. Changes in the sella indicative of an extrasellar tumor were found in 34 cases, and evidence of an intrasellar lesion in 29 cases.

Calcification in the tumor was demonstrated roentgenographically in only 56 per cent of the cases, although microscopic evidence was seen in 77 per cent. The calcium shadows were suprasellar in 39 cases, intrasellar in 4, and both suprasellar and intrasellar in 13 cases. In 26 cases, roentgenograms of the skull revealed no intracranial changes.

Ten patients who received roentgen-ray therapy experienced remission or abatement of symptoms that could be definitely attributed to irradiation. [A more detailed report of these 10 cases has been published by Leddy and Marshall in RADIOLOGY (**56:** 384, March 1951).] The surgical treatment of pituitary adamantinomas is discussed briefly, and the end-results are given for 96 cases.

Two roentgenograms; 2 photographs; 3 photomicrographs; 6 drawings. J. L. JARVIS, M.D.
University of Pennsylvania

A Roentgen and Clinical Contribution on Fetal Hypophyseal Adenoma. L. Psenner. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 586–590, March 1950. (In German)

Relatively little mention has been made in the literature of fetal adenomas of the pituitary. The author reports a case in a 35-year-old woman with homonymous hemianopsia and central scotoma in the right eye, partial loss of vision, headache, pain in the eyes, dizziness, and vomiting. Amenorrhea had been present for twelve months. General and neurological examinations were otherwise negative; there were no changes in the general bodily aspects and no recognizable endocrine symptoms. X-ray examination showed gross destruction of the sella turcica, particularly posteriorly, with enlargement of the pituitary fossa, a soft-tissue mass protruding into the posterior portion of the sphenoid sinus, and some measure of sharpening of the anterior clinoid processes. There were no calcium deposits. At operation a moderately large tumor was found causing pressure on the optic chiasm. It was highly vascular in nature and could not be completely removed.

In considering the diagnostic criteria of fetal adenomas of the pituitary the author states that the tumors may be small or large, but the patient shows relatively little in the way of clinical or endocrine symptoms. The tumor is benign, enlarging the sella and destroying bone, projecting into the sphenoid sinus through pressure or arising within the sinus or bone and projecting upward.

In the case reported here amenorrhea was the only symptom of endocrine origin and menstruation returned after operation.

Two roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Roentgen Diagnosis of Pathological Defects Due to Toxoplasmosis. Johannes Schoeps. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 577–586, March 1950. (In German)

The organism of toxoplasmosis is transferred from mother to fetus through the placental circulation, and recognizable changes are often present at birth. *Toxoplasma* shows an especial affinity for the brain, central nervous system, and eye. Focal necrotic areas develop in the meninges and especially the choroidal plexus, later calcifying and becoming identifiable on the x-ray film. The diagnosis is confirmed by antibody neutralization and complement-fixation tests. These are positive at birth or in premature infants, but in most cases become negative during the first few years of life.

Roentgenograms show multiple bilateral calcifications in the choroid, brain substance, and meninges. At first the calcium deposits appear as very faint nebulous areas; later they are denser and sharply demarcated, persisting throughout life. In many cases there is secondary obstruction of the aqueduct or other parts of the ventricular system, with internal hydrocephalus.

The calcifications of toxoplasmosis are usually easily differentiated from a calcified pineal or falx cerebri,

arteriovenous aneurysm, Sturge-Weber syndrome, and calcium deposits in tuberculomas, tumors, cysts, and hematomas.

To summarize, the cardinal diagnostic features are intracranial calcification, bilateral and very often in the region of the choroid plexus; internal hydrocephalus due to pressure on the aqueduct of Sylvius; changes in the eye, post chorioretinitis with colobomata, malformations of the globe, degenerative changes, and disturbance of innervation of the ocular muscles; antibody neutralization and positive complement-fixation tests (of greatest value in young children).

Four cases are reported, with 14 roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Percutaneous Angiography of the Vertebral Artery. E. Lindgren. Acta radiol. **33:** 389–404, May 1950.

A brief description of the various approaches to the delineation of the vascular bed in the posterior fossa with contrast media is presented. Difficulties associated with the operative technic and failure of previous attempts at subclavian and vertebral artery injection prompted a new method, whereby the vertebral artery is punctured directly from in front.

Plain films of the cervical spine are first obtained to determine the presence of disk degeneration or osteophytes which might interfere with the procedure. Under local anesthesia the needle is aimed directly at the vertebral artery between the transverse processes. This is done high in the neck, where degenerative vertebral changes are less common. The common carotid artery is manually displaced laterally during the procedure. Blood should be withdrawn high into the glass tube of the apparatus before injection, to insure actual engagement of the artery rather than the subarachnoid space. In two-thirds of the cases a percutaneous puncture is possible.

At the time of the report, the author had performed 60 percutaneous vertebral angiographies, with two relatively serious complications, temporary optic aphasia in one case and mental confusion of twenty-four hours duration in the other. He describes the normal variations observed in the course of the basilar artery and points out the difficulty of judging the presence and localization of an expanding tumor on the basis of displaced vessels. For determining the location and size of such a lesion, he considers pneumography more reliable. In case of recurrent tumor, however, angiography may be more valuable, especially in vascular neoplasms.

Percutaneous vertebral injection finds its greatest use in the study of vascular tumors such as aneurysms and arteriovenous aneurysms. Two illustrative cases are reported.

Twenty-four roentgenograms; 4 anatomical illustrations.

MILTON SEGAL, M.D.
Cleveland City Hospital

Oxycephaly. Martin Bodian. J. A. M. A. **143:** 15–18, May 6, 1950.

Oxycephaly results from premature closure of cranial sutures, giving rise to a high skull shortened in the anteroposterior diameter. The palate, upper teeth, and facial bones may be deformed. The cranial foramina are often constricted with resulting damage to nerves and blood supply.

The roentgenologic appearance of the skull is diagnostic, especially if lateral as well as anteroposterior views are taken. The tall, thin-boned calvarium with its short sagittal diameter shows numerous saucer-like concavities on its inner table. These digital depressions supposedly represent convolutions of the brain. They resemble the surface of beaten silver greatly magnified. The vessel markings are deeply etched. Bony suture lines may be completely obliterated, and the orbits may be compressed to resemble a flattened letter C. The floor of the middle cranial fossa may be pushed down to the level of the posterior fossa. The anterior fossa is shortened and distorted. Associated bony anomalies may be found in the spine and extremities. Mental development may be normal or defective.

Many ocular abnormalities occur: exophthalmos, lagophthalmos and corneal ulceration, strabismus, and optic atrophy with consequent poor vision or blindness.

Little can be done for oxycephaly therapeutically once the condition is matured. However, early resort to neurosurgical procedures such as decompression and repeated lumbar punctures may prevent the dreaded consequences of intracranial hypertension.

A typical case of oxycephaly in a 16-year-old Negro boy, with optic atrophy but normal intelligence, is reported. The roentgen findings were characteristic.

Two roentgenographs; 4 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Gargoylism (Lipochondrodystrophy). A Study of Ten Cases, with Emphasis on the Formes Frustes of the Disease. George A. Jervis. Arch. Neurol. & Psychiat. **63:** 681–712, May 1950.

Gargoylism (lipochondrodystrophy, or Hunter-Hurler syndrome) is a well defined type of mental defect. In fully developed cases there is a typical grotesque facial appearance, due to a combination of prominent frontal bones, depressed nose, high malar bones, large mouth, thick lips, and hypertelorism. Multiple and varying deformities of bone are present. The vertebrae show irregularities of outline, and variation in size. They may be wedged in places, with a peculiar hook-like process at the anterior aspect. The patients are dwarfed. There are elongation of the sella turcica and multiple bony deformities of the limbs. Mental deficiency is an integral part of the clinical picture and is often accompanied by neurological signs of central nervous system damage. The liver and spleen are enlarged. Opacities of the cornea are frequent.

In its complete form, the disease is easily recognized, but the *formes frustes*, in which the clinical manifestations are less striking, often escape recognition. Seven cases of this latter type are presented. The diagnosis in these was based upon the association of mental deficiency and the characteristic bone deformities, including those of the skull, face, and spine. Lesions of the vertebrae were present in all 7 cases, and dwarfism in all but one. Deformities of the skull and the peculiar facies were seen in all. Evidence of alteration in the bony structure of the extremities was less marked than in complete gargoylism, but the difference was one of degree rather than nature. The fact is stressed that deformities of bone in these *formes frustes* may be so slight as to escape notice unless careful roentgen examination is made of the skeletal system.

The author discusses the pathology and etiology of

gargoylism and includes a table presenting the main features of 148 cases reported in the literature (with references).

Fifteen roentgenograms; 4 photographs; 6 photomicrographs; 3 tables. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Altered Dimensions and Abnormal Form of the Optic Canal as a Predisposing Factor in Affections of the Optic Nerve. Nicolas Blatt, Mircea Athanasiu, and V. Popovici. J. de radiol. et d'électrol. **31**: 267–271, 1950. (In French)

Flattening of one dimension of the ovoid optic canal and foramen may be a predisposing factor in conditions affecting the optic nerve. The authors present the case of a 23-year-old tuberculous male receiving streptomycin, in whom an involvement of the eighth nerve developed, followed by an optic neuritis. The left optic foramen was flattened in one dimension and the surrounding bone was dense in comparison to the normal right side. In addition, the anterior clinoids were thickened and opaque, and the spine of the sella had an osteophytic aspect.

Five roentgenograms; 5 drawings.
CHARLES NICE, M.D.
University of Minnesota

Congenital Arteriovenous Fistulas in the Mandible. Richard C. Clay and Alfred Blalock. Surg., Gynec. & Obst. **90**: 543–546, May 1950.

Although congenital arteriovenous fistulae are not common, they are most frequently found in the head or neck. The authors report the first two cases proved at operation to be within the mandible. The signs and symptoms common to both cases were (1) a progressive unilateral enlargement of the face, (2) roaring in one ear, (3) exertional dyspnea, and (4) a thrill and a machinery murmur over the swelling. Erosion of the mandible was seen on the roentgenogram in one case, and a rim of calcium, presumably in the wall of the aneurysm, was apparent in close proximity to the area of bone destruction. In the other patient, films of the mandible showed expansion of the ramus and part of the body of the bone by a cystic process, as well as an extramandibular soft-tissue mass containing calcium deposits.

The existence of arteriovenous fistulas of the mandible in these two cases suggests the advisability of x-ray investigation of the mandible in any case of an arteriovenous fistula in the face or neck. Where it is technically possible, all arteriovenous fistulas should be repaired, because many of their complications (such as disfigurement, rupture of a vessel, gangrene, septicemia, and cardiac failure) are serious. Should evidence of bone erosion be detected, preparation for mandibular resection must be made, as this may be the only way to control bleeding and eradicate the fistula.

Two roentgenograms; 4 photographs; 1 drawing.
RICHARD V. WILSON, M.D.
University of Pennsylvania

Odontogenic Cysts and Cystic Tumors of the Jaws. A Roentgen-Diagnostic and Patho-Anatomic Study. Anders Sonesson. Acta radiol., Suppl. LXXXI, 1950.

A comprehensive review of cystic disease of the jaws is presented from the radiologic point of view, with an adequate histopathologic background. Although the title usage of the word "cyst" is intended to encompass all forms of odontogenic cyst formation, as well as bone-displacing or osteolytic tumors of the solid type, these subdivisions of the radiological problem are separately and adequately covered in compliance with a sound and conventional classification scheme. Brief but relevant case histories accompany most of the illustrations and a section dealing with appropriate therapy accompanies the orderly discussion of the disease entities.

Following a detailed presentation of the embryology, anatomy and histology of the jaws, the author considers epithelium-lined odontogenic cysts, the first major division of his classification. In this group are discussed in detail the occurrence, symptomatology, etiology, pathology, and radiographic appearance of radicular cysts, primordial (simple follicular) cysts, dentigerous cysts, and cystic odontomas.

Similar evaluation is given odontogenic tumors in the second major division of the subject material. Adamantinomas merit the principal discussion in this section and are amply illustrated by 29 reproductions of microscopic sections and roentgenograms. Central fibromas, fibromyxomas, and cementoblastomas are presented more briefly but without sacrifice of significant detail.

Differentiation of non-odontogenic cysts and solid tumors from the previously discussed odontogenic lesions comprises the final major division of the study. Sufficient data of diagnostic importance are presented to make a strong case for the author's position that a significantly large proportion of radiolucent lesions within the jaws may be diagnosed by the careful radiologist. Many of the finer points of differential diagnosis which he stresses might be profitably applied to other parts of the skeleton if the same exacting approach is made. The monograph concludes with a summary which in itself presents an excellent orientation in the field under consideration.

The extreme importance of optimum radiographic quality is stressed and supported by the very high technical quality of the illustrations. The halftone engravings do not suffer from the excess contrast too often seen in contemporary publications and present a worthy goal to the technician and engraver alike.

One hundred and twenty-one illustrations, including 110 roentgenograms. EARL R. HAYNES, M.D.
The Henry Ford Hospital

THE CHEST

Foreign Bodies in Air and Food Passages. Observations on Series of 85 Cases. Oliver W. Suehs. Texas State J. Med. **46**: 298–303, May 1950.

In a series of 85 cases seen by the author, the ratio of foreign bodies in the food passages to those in the air passages was 3 to 1. A number of factors enter into the etiology besides carelessness. The author mentions the instinctive tendency of infants to put things in their mouths, poor dentition or the presence of dentures, rendering the hard palate insensitive to bones or other objects, the tendency of the insane to swallow objects, and the commercial practice of chopping instead of disjointing chickens.

In the larynx a foreign body will cause hoarseness and cough and possibly dyspnea. If sharp, it may produce discomfort on swallowing. With a foreign body in the trachea or bronchi there is an initial episode of

choking, which may be followed by a symptomless interval. In some instances there are continuous wheezing and dyspnea. Later, depending on the degree of obstruction and reaction of the lungs, obstructive emphysema, atelectasis, and lung abscess may occur. In the esophagus, a foreign object produces dysphagia with pain on swallowing if it is long and pointed.

The importance of a careful roentgen examination cannot be overestimated, but its value depends largely upon the skill and experience of the roentgenologist in interpretation of foreign-body roentgenograms. Obviously, an opaque foreign body in the air or food passages is readily recognized, but diagnosis of a nonopaque object in the trachea or bronchus requires a careful fluoroscopic and roentgen study of the changes that occur in the lungs during the respiratory cycle.

Fluoroscopic and roentgen findings are most marked at the end of expiration and consist of (1) increased aeration of the affected lobe or lung as a result of the trapped air, (2) depression of the diaphragm on the same side, (3) displacement of the heart and mediastinum toward the sound side, and (4) compensatory emphysema of the sound lung.

When a bronchus has become completely obstructed, the signs are those of atelectasis. Pneumonitis and drowned lung are observed in patients in whom the foreign body has had a longer sojourn with resulting secondary infection.

The diagnosis by roentgenogram of esophageal foreign body is less difficult, but good lateral films are essential. A slender spicule of bone is often overlooked and, if hidden in the folds of the cricopharyngeus, may escape detection even with barium.

There was one fatality in the author's series, a 10-month-old infant, moribund when first seen. A swollen bean was found completely obstructing the trachea, but respiration ceased before it could even be grasped. Emphysema of the neck followed removal of a bolus of meat from the lower esophagus in another patient, but this cleared rapidly without infection.

Six roentgenograms; 4 tables.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Radiological Demonstration of Apical Lung Lesions. E. G. Hoffstaedt. Radiol. clin. **19:** 164–169, May 1950. (In English)

In the author's opinion, most of the anteroposterior and postero-anterior views commonly employed for demonstration of apical lung lesions are not satisfactory. First, they are difficult to apply where the cassette holder is more or less mobile, fitted in front of an ordinary screening stand. Secondly, with the patient bending either forward or backward, the picture tends to be blurred. A new technic has been developed, which is equally applicable whether the cassette holder is fixed or mobile, and which leaves the patient in upright position close to the cassette face. The patient leans firmly with his back against the cassette, chin up and shoulders rotated outward as usual. (In case of a mobile cassette holder in front of an ordinary screening stand, the patient faces the screening stand, turning his back against the cassette.) The horizontal focus-film distance is 36 inches. The tube is tilted upward 30 degrees from the horizontal plane, the height being adjusted so that the central ray hits the lower border of the clavicle. The cassette must be placed rather high up with its upper margin just below the vertex. If an ordinary screening stand is used, the proper level can easily be adjusted beforehand. Exposure is the same as in routine chest radiography at a focus-film distance of 45 inches. The actual focus-film distance at 36 inches, if measured along the oblique central ray, is about 41.5 inches.

The oblique projection from the relatively shorter distance enlarges the size of the apical structures on the film, and this magnification is helpful, particularly in lesions of doubtful pathological significance. Details invisible or indistinguishable on the ordinary view are often surprisingly brought to light. Not only is the clavicle well above the apical lung fields, but the anterior, mesial parts of the first two ribs are also thrown out of the apical area by this technic. There is no blurring of the picture as with other methods, and tomography is often unnecessary.

Eleven roentgenograms; 1 drawing.

New Instruments for Bronchography. Åke S. Gidlund. Acta radiol. **33:** 421–426, May 1950.

A new instrument for surface anesthesia by topical spraying along the entire course of the respiratory tract is described. It consists of a tube which is introduced into the respiratory system and which is provided with an interchangeable nozzle. The anesthetic is applied under pressure from a glass container, by compressed air. The volume flow of the anesthetic and to some extent the size of the particles can be regulated by the rheostat controlling the compressor.

After anesthesia of the pharynx, with the patient lying on his back, the instrument is introduced into the larynx with the aid of the laryngoscope. The anesthetic is sprayed as the instrument is pushed deeper and into the desired bronchus. In about four minutes, the full anesthetic effect should be obtained.

The instrument for introducing the contrast medium consists of a long tube covered in part by rubber (A) and having a detachable nozzle (D). The contrast medium is introduced through the nozzle at the opposite end (C). The instrument can be bent up to a maximum angle (slightly greater than 90 degrees) by pressing together the shanks (B) which are pivoted to the tube. In this way it can be introduced into each bronchial trunk. The shanks are then removed and the instrument fixed by means of a head band. The contrast medium can now be injected. The author prefers easily absorbed, thick-flowing, water-soluble medium. The nozzle can be replaced by a special nozzle for excision of tissue for biopsy.

Seven illustrations.

SHOZO IBA, M.D.
Cleveland City Hospital

Pulmonary Hydatid Disease. A Review of 478 Cases Reported in the Louis Barnett Hydatid Registry of the Royal Australasian College of Surgeons. Norman Waddle. Australian & New Zealand J. Surg. **19:** 273–290, May 1950.

The records of 478 cases of pulmonary hydatid disease are analyzed, with follow-up in 96.

Pulmonary hydatid disease occurs in sheep-farming areas where the disease is endemic among dogs. The parasite probably reaches the lungs *via* the thoracic duct, thus by-passing the liver, for although pulmonary cysts are less common than those in the liver, the two are rarely associated. Although the disease may be present for years, it becomes apparent chiefly in the 20-to-30-year age group, when leakage of cyst contents or bacterial infection of the cyst gives rise to a pneumonitis, with cough, sputum, hemoptysis, and pain. The signs and symptoms are non-specific and because of their persistence and recurrence may suggest pulmonary tuberculosis and other chronic lung diseases, such as bronchiectasis, pulmonary abscess, or bronchogenic carcinoma. Males are more commonly affected than females. The diagnosis is made by finding the parasite in the sputum, by x-ray studies, and specific laboratory tests. Roentgenography is not only of the greatest value in diagnosis but is also essential for preoperative localization of the cyst. Laboratory tests will give positive results in only 70 per cent of the cases. Eosinophilia is of no diagnostic significance.

A few cases present as catastrophes, due to rupture of a cyst, with resulting copious hemoptysis, asphyxiation due to blocking of the tracheobronchial tree with hydatid fluid, or spontaneous hydropneumothorax. Spontaneous cures may follow rupture of the cyst and evacuation of the contents by vomiting, but this is hazardous to the patient. Once it has occurred, observation should be maintained over a period of time, and infection, if it develops, should be treated surgically.

The majority of cases are best treated with surgery, which entails removal of the cyst only. Rigid technic must be used as a precaution against spilling the contents of the cyst in the operative field. After removal of the cyst, there may be permanent bronchiectasis. In the series reviewed the bronchiectasis remained symptomless in a majority of cases. Lobectomy or pneumonectomy is indicated only where infection has occurred in the cyst and has involved the surrounding lung.

Ten roentgenograms; 3 graphs; 7 tables.

GABRIEL WHITEMAN, M.D.
Louisville, Ky.

The Occurrence of Pulmonary Tuberculosis Following Pulmonary Excision for Nontuberculous Diseases. Harry L. Katz. Am. Rev. Tuberc. **61:** 835–844, June 1950.

The author presents a series of four cases in which pulmonary tuberculosis developed in periods ranging from five to sixteen months following pneumonectomy or lobectomy. The tuberculosis was of the far advanced caseous-pneumonic type with cavitation and involved the emphysematous upper lobe on the operated side in the 3 patients who had had lobectomy; in the patient who had had a pneumonectomy the tuberculosis was exudative in type and moderate in extent.

The over-distention of the remaining lung parenchyma, as well as the manipulation of the lung during surgery, may serve as a form of trauma in producing a *locus minoris resistentiae* for an exogenous reinfection or activation of an endogenous focus. In addition, the compensatory emphysema in a remaining lobe may result in enough stretching to open an existing inactive tuberculous focus. The author feels, therefore, that there is a causal relationship between the surgery and the tuberculosis which followed it. He emphasizes the need for a careful postoperative follow-up program by means of chest roentgenograms in order to detect changes before they become extensive.

Fifteen roentgenograms; 1 table.

JOHN H. JUHL, M.D.
University of Wisconsin

Primary Coccidioidomycosis and Concomitant Tuberculosis. Marcel Kahn. Am. Rev. Tuberc. **61:** 887–891, June 1950.

A case report is presented by the author to bring out some of the difficulties in evaluating the clinical and laboratory findings, as well as the roentgenographic findings, in a patient having an acute pulmonary disease, with tuberculin and coccidioidin tests negative at the onset but becoming positive in approximately three weeks. In addition, sputum culture yielded a growth of *Coccidioides immitis* and several sputum specimens were positive for the tubercle bacillus.

A chest roentgenogram on admission showed a triangular area of poorly circumscribed density at the right base which cleared slowly and had not regressed completely in three months. It was finally concluded that the patient apparently had simultaneous primary tuberculosis and coccidioidomycosis.

Two roentgenograms; 1 chart.

JOHN H. JUHL, M.D.
University of Wisconsin

Results That Are Obtained in Mass X-Ray Survey. Julius B. Novak and Theda L. Waterman. Illinois M. J. **97:** 262–264, May 1950.

The findings in this paper are based on 14,998 chest films taken in a local survey in Cook County, Illinois. Of these, 236, or 1.5 per cent, were regarded as showing possible tuberculosis, and 490, or 3.5 per cent, as indicative of other chest lesions. Of the 236 persons suspected of having tuberculosis, 195 were studied with 14 × 17-inch films; 69 were negative, 114 showed reinfection tuberculosis, 4 primary active tuberculosis, and 7 non-tuberculous lesions. Of the reinfection cases, 54.5 per cent were considered minimal, 31.6 per cent moderatly advanced, and 3.5 per cent far advanced.

After a thorough clinical study, only 12 cases of active tuberculosis were found, 6 of which were already known and under treatment.

In a final summary the authors state that, although mass surveys yield only a small number of active cases, they nevertheless seem to be profitable.

Seven tables.

E. KASH ROSE, M.D.
University of Louisville

Chest Lesions Often Confused Roentgenographically with Primary Cancer of the Lung. Paul C. Swenson and Robert H. Leaming. Am. J. Roentgenol. **63:** 629–645, May 1950.

The roentgenograms from 23 cases of obvious peripheral chest lesions are presented to emphasize the present-day limitations of roentgen differentiation of primary cancer of the lung from non-cancerous conditions. Roentgenography, however, still remains the only way of making an early diagnosis of a peripheral lesion beyond the reach of the bronchoscope and other laboratory examinations.

Various inflammatory lesions are continually confused with possible cancer. These include cholesterol,

lipoid, and non-specific indurative pneumonias, non-specific granulomas, bronchiectasis, lung abscess, and suppurative disease of the pleural space. Pictures identical with neoplastic bronchostenosis are seen in fibrotic constriction of a bronchus due to syphilis or tuberculosis.

Certain benign neoplasms such as lipomas, neurofibromas, chondromas, and adenomas may be indistinguishable from carcinoma of the lung. Cysts or thin-walled cavities containing fluid may closely resemble a cavity resulting from a necrotizing tumor. Pulmonary adenomatosis may be masked by a picture indistinguishable from a diffuse inflammatory process.

Infarcts, obstructive broncholiths, and single metastatic malignant lesions can produce pulmonary densities which, in the absence of proper correlative clinical evidence, can be distinguished from primary cancer only by an exploratory thoracotomy.

The fact that not infrequently the pathological material removed in lobectomy or pneumonectomy cannot be grossly identified as cancerous or non-cancerous would strongly support the authors' idea that this distinction is often impossible roentgenologically.

Forty-seven roentgenograms; 1 photograph.

J. A. CAMPBELL, M.D.
Indiana University

Bilateral Alveolar Lung Carcinoma, Associated with the Injection of Thorotrast. L. Abrahamson, M. H. O'Connor, and M. L. Abrahamson. Irish J. M. Sc., pp. 229–235, May 1950.

In the case reported here thorotrast had been injected intravenously (75 c.c.) for hepatosplenography sixteen years before the patient's death as a result of an extensive alveolar-cell carcinoma involving all lobes of both lungs. Typically, in spite of the widespread lung involvement, the only metastases found at autopsy were a few small bronchial nodes and a small nodule in the pancreas. Dyspnea, weight loss, and productive cough were the clinical features of the eight months downhill course. Microscopically practically all the alveoli of both lungs were found to be lined with a columnar mucus-secreting epithelium instead of the usual flat cells.

The authors discuss the possible origin of the tumor, mentioning the controversy over whether or not normal lung alveoli are actually lined by epithelium, and the possible relationship of alveolar tumors in man to the pulmonary adenomatosis of sheep, or "Jaagziekte." The apparent multicentric origin, relatively slow rate of growth and high grade of differentiation led the authors to believe that the thorotrast was responsible for the tumor. [While there is no way to rule out such a possibility, this seems like *post hoc propter hoc* reasoning, since other exactly similar cases have appeared in the literature, with no history of thorotrast administration. Furthermore the lungs contained no measurable thorium at autopsy and the alpha radiation which it produces penetrates only a few adjacent cells—Z. F. E.]

Four roentgenograms; 4 photomicrographs; 4 photographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Pulmonary Adenomatosis. Clinical Review and A Report of Three Cases. A. B. Weir, Jr. Arch. Int. Med. **85:** 806–818, May 1950.

Pulmonary adenomatosis is a rare disease in which the alveoli of the lungs are lined by low columnar or high cuboidal cells in one to many layers. Papillary projections and detachment of groups of the cells into the alveoli are common. The disease probably is neoplastic. The salient clinical features are: occurrence in middle or late life; persistent cough; characteristic white, frothy, odorless sputum; dyspnea; late cyanosis; usual absence of fever, hemoptysis, anemia and leukocytosis (except with bacterial complications).

Roentgen examination may reveal multiple small areas of increased density, discrete or irregular, or larger segmental and lobar areas of consolidation. In most patients, when first seen, there is extensive involvement of the lungs. Progressive involvement may be observed over long periods of time. The condition has been bilateral in 27 of 33 cases recorded in the literature.

Treatment has been of value in only one patient, who had a pneumonectomy. Three patients, including one of the author's, received roentgen therapy without favorable response.

Three cases of pulmonary adenomatosis, one of which was diagnosed clinically, are presented.

Six illustrations, including 2 roentgenograms; 2 tables.

HOWARD L. STEINBACH, M.D.
University of California

Intrathoracic Ganglioneuroma. J. G. Rogers and J. P. Keogh. Dis. of Chest **17:** 532–543, May 1950.

Ganglioneuromas originate from the cells of the anlage of the sympathetic chain. According to Bigler and Hoyne (Am. J. Dis. Child. **43:** 1552, 1932), tumors of the sympathetic nervous system are divided into three groups: (1) neuroblastomas, derived from neuroblasts, (2) chromaffinomas or paraganglioneuromas, originating from pheochromoblasts, and (3) ganglioneuromas, developing from adult ganglion cells. The ganglioneuroma is usually benign; malignancy is due to the presence of neuroblastic elements forming a mixed tumor.

Ganglioneuroma is found predominantly in the earlier age groups. In the chest, it is usually single, arising in the posterior gutter, extending anterolaterally, and displacing the mediastinal pleura in front of it as it enlarges. It does not invade the lung. The symptoms depend upon the size and location of the tumor and are the result of pressure upon adjacent nerves, bronchi, and blood vessels. Protrusion into a vertebral foramen may produce pressure on the cord.

A roentgen examination reveals a well circumscribed mass, usually in the posterior mediastinum. There may or may not be erosion of bony structures, as a rib or vertebral body.

The authors include the case history of a young colored female, aged 26, in whom a preoperative diagnosis was made. The patient was successfully operated upon and the diagnosis verified.

Since Heuer and Andrus (Am. J. Surg. **50:** 146, 1940) collected 68 intrathoracic ganglioneuromas from the literature, 21 cases have been reported besides the authors'. References to these reports are appended.

Three roentgenograms; 2 photographs; 1 photomicrograph; 4 tables.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Resection of an Intrathoracic "Hibernoma." C. Frederick Kittle, James O. Boley, and Paul W. Schafer. J. Thoracic Surg. **19:** 830–836, June 1950.

"Hibernoma" is a term introduced by Gery in 1914 to designate an atypical lipoma derived from the human

homologues of the hibernating glands of animals. Hibernating glands, known also as interscapular glands, have been found in man as paired, light brown, lobulated irregular vascular masses situated on the shoulder and side of the neck between the superior borders of the scapula and calvicle. The tumor in the authors' case measured 14 × 12 × 8 cm. and occupied the posterior part of the left pleural cavity. The patient was a female forty-two years of age. She had had a slight cough for five years, which for the last six months had been productive and accompanied by wheezing.

Lateral and postero-anterior chest films demonstrated a large homogeneous area of density continuous with the chest wall posterolaterally and presenting a smoothly convex profile anteriorly. At operation a large, firm, ovoid, bosselated tumor of a grayish orange color was found, attached to the chest wall by a base 5 cm. in diameter and bound by vascularized adhesions to the upper and lower lobes of the left lung. Within the tumor were translucent myxomatous areas. The microscopic picture was that of an atypical lipoma.

Many chemical and other laboratory procedures were conducted on the tumor and compared with the same tests done on a large subcutaneous lipoma. One of the most marked differences was the melting point of 22° C. for the lipoma as compared with a melting point of 1° for the "hibernoma."

The article includes reproductions of the chest roentgenograms as well as a drawing of the tumor at the time of surgery and gross and microscopic photographs of the specimen.

HAROLD O. PETERSON, M.D.
University of Minnesota

Pneumothorax in Lung Collapse. Simon Schereschewsky. Radiol. clin. **19:** 170–173, May 1950. (In German)

The author describes a female patient who was admitted to the hospital as an emergency case. Roentgen examination of the chest revealed a complete collapse of the left lung, with marked displacement of mediastinal structures, trachea, bronchi, and heart to the left. The patient was in severe cyanosis and distress.

In such cases, as a result of displacement of the bronchus and obstruction, the affected lung does not get sufficient air and the negative pressure on the affected side of the thorax increases, thus causing the characteristic shift of the mediastinum.

An artificial pneumothorax was produced on the left side, as a therapeutic measure. Heart and mediastinum then assumed their normal positions, and the patient was immediately relieved of the dyspnea and cyanosis. The obstruction of the bronchus was caused by a mucous plug and granulation tissue. Recovery was uneventful.

Three roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Mesothelioma of the Pleura. R. E. Whitehead. Dis. of Chest **17:** 569–577, May 1950.

Mesothelioma of the pleura is a rare malignant neoplasm occurring in about 1.1 cases per 1,000 necropsies. It is most frequently seen between the ages of forty and sixty, and more often in males. The clinical signs and symptoms are confusing. Cough and dyspnea are of constant occurrence. Stridor may develop as a result of pressure on and obstruction of bronchi by enlarged lymph nodes while compression of the larger thoracic veins will cause dilatation of superficial veins. Expectoration may be moderate or profuse, and gelatinous or mucopurulent because of secondary infection. Blood streaking and hemoptysis are not usually present. Temperature is usually normal unless a secondary infection is present. Pain is pleuritic in character and may be severe over the affected side.

Roentgen examination may first show a pleural effusion and a thickened pleura. A thoracentesis and induction of an artificial pneumothorax may permit the demonstration of multiple smooth tumors of various size. Later there are signs of atelectasis.

The author gives the case history of a 62-year-old male, who complained of cough, profuse expectoration, shortness of breath, pain in the left chest, weakness, and hoarseness. Roentgen examination disclosed a large homogeneous shadow in the upper two-thirds of the left lung field. Eleven days later another examination showed this to be a multilobulated mass extending from the anterior to the posterior chest wall. The patient died after twenty-two days in the hospital. The tumor proved to be a mesothelioma.

One roentgenogram; 2 photomicrographs.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Benign Fibroma of the Pleura. Report of a Case. Herbert R. Hawthorne and Alfred S. Frobese. Dis. of Chest **17:** 588–596, May 1950.

Primary neoplasms of the pleura are uncommon. They may be divided into two groups: (1) diffuse lesions arising from the membranous lining of the pleura, usually designated as endotheliomas or mesotheliomas, though believed by some pathologists to be carcinomas; (2) solitary or localized growths, arising from the subendothelial connective tissue, including fibromas.

The authors give the case history of a woman of forty, in whom a large intrapulmonary lesion was found, resected, and microscopically proved to be a fibroma. It measured 15.5 × 10.5 × 7.0 cm. and weighed 1,000 gm.

The point of origin of these giant fibromas, whether from the visceral or parietal pleura, is in question. In most instances, they are completely invested with visceral pleura and are attached to the lung by a small pedicle. They are benign, occur at any age, and are more common in women. Symptoms depend upon the size and location of the space-occupying mass and are due to mechanical interference with respiration and circulation. They include non-productive cough, pain, distention of neck veins, dysphagia, and pretibial edema. The roentgenogram shows a uniformly dense opacity, with a sharp outline, and compression of lung tissue. A pleural effusion may be present. A bronchoscopic examination is necessary to exclude an intrabronchial lesion. A bronchographic examination will show the displacement and lack of filling of the bronchi. Pneumothorax or pneumoperitoneum with subsequent roentgenography will aid in the exclusion of intra-abdominal disease.

Six illustrations, including 3 roentgenograms.

HENRY K. TAYLOR, M.D.
New York, N. Y.

Hemorrhagic Pleural "Cysts." J. Mathey and P. Mannes. J. franç. méd. et chir. thorac. **4:** 446–449, 1950. (In French)

Small pockets of pleural hemorrhage may gradually

disappear. However, in some cases, the encysted hemorrhage may become surrounded by a hard, thick wall and assume the character of a pleural cyst. Surgical removal results in recovery. Two cases are reported.

Four roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Spontaneous Mediastinal Emphysema and Bilateral Spontaneous Pneumothoraces. Bernard Hyde and LeRoy Hyde. Am. Rev. Tuberc. **61:** 883–886, June 1950.

The occurrence of bilateral spontaneous pneumothorax associated with mediastinal emphysema is evidently quite rare. In the case reported, spontaneous mediastinal emphysema and a right-sided pneumothorax were observed on the first hospitalization, with development of bilateral pneumothorax and mediastinal emphysema about three weeks later. No cause was evident on chest roentgenograms and the patient recovered without complication following a short period of bed rest.

Five roentgenograms.

JOHN H. JUHL, M.D.
University of Wisconsin

Mediastinal Parathyroid Adenoma. Report of a Case with Unusual Fatal Course. Wilbert Staub, David M. Grayzel, and Philip Rosenblatt. Arch. Int. Med. **85:** 765–776, May 1950.

Parathyroid adenoma is rarely thought of in the differential diagnosis of mediastinal tumors. A case is presented of hyperparathyroidism due to a parathyroid adenoma located in the mediastinum. The lesion was demonstrated by roentgenologic examination as a smooth ovoid mass about 3 inches in greatest diameter, which appeared to be anterior and slightly to the left of the main pulmonary artery. Angiocardiography ruled out the possibility of an aneurysm of the pulmonary artery.

Roentgen therapy was administered as a therapeutic test, 2,000 r being given through two portals over a period of five days. The estimated tumor dose, physical factors, and size of the fields are not given. Following roentgen therapy the course was rapidly downhill, with death apparently due to acute parathyroid hormone intoxication. It was thought that the irradiation of the parathyroid tumor may have caused increased liberation or secretion of the parathyroid hormone.

Seven illustrations, including 1 roentgenogram.

HOWARD L. STEINBACH, M.D.
University of California

Primary Angiosarcoma of the Heart. Hall S. Tacket, Russell S. Jones, and J. Warren Kyle. Am. Heart J. **39:** 912–917, June 1950.

The clinical and pathological findings in a case of primary angiosarcoma of the right atrium are presented. The patient presented outstanding evidences of cardiac tumor: signs of right heart failure, bloody pericardial effusion, and irregularity of the cardiac border on the roentgenogram. The cardiac silhouette was enlarged; the contour was water-bottle in shape, but with a nodular protuberance on the right border. At fluoroscopy, cardiac pulsations were absent. Several calcified lesions were seen throughout both lung fields. The findings were interpreted as representing pericardial effusion due to metastatic tumor.

The patient failed to improve after pericardial tap and died within twenty-four hours. Autopsy revealed an angiosarcoma of the right atrium with metastases to the right ventricle and the lungs, hemopericardium, and severe chronic passive congestion of the abdominal viscera.

Four figures, including 1 roentgenogram.

Retrograde Arteriography in the Diagnosis of Cardiovascular Lesions. II. Coarctation of the Aorta. Norman E. Freeman, Earl R. Miller, H. Brodie Stephens, and Mary B. Olney. Ann. Int. Med. **32:** 827–841, May 1950.

Retrograde carotid arteriography was employed by the authors in 15 patients with a clinical diagnosis of coarctation of the aorta. The examination was successful in 13 of the group, with no serious complications. It was possible to demonstrate the location, type, and degree of coarctation in a majority of these patients. In 4 cases, an unnecessary thoracotomy was avoided. The technic of exposing the left common carotid artery under local or general anesthesia, injecting the diodrast, and obtaining the films is described.

Coarctation of the aorta should be suspected in all children and young adults with hypertension. Diminution or absence of all the femoral pulses will frequently support this diagnosis. Search should then be made for evidence of increased collateral circulation about the upper thorax. A chest roentgenogram is of value but is not infallible, since notching of the ribs is not invariably seen. It is unusual in children, before the development of extensive collateral circulation. Dilatation of the left subclavian artery and absence of the aortic knob are suggestive of the diagnosis but are not conclusive.

Introduction of radiopaque material into the aorta directly above the zone of narrowing, by way of the left common carotid artery, will show not only the location of the coarctation but will demonstrate its degree and extent.

Details of the 15 cases are presented in tabular form and 13 case histories are included.

Six roentgenograms; 1 drawing.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Apparatus and Technic of Cineroentgenography in Demonstration of the Heart Chambers and Great Vessels. R. Janker. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 513–520, March 1950. (In German)

During recent years there has been marked advance in the accuracy of diagnostic procedures in congenital heart conditions. Motion picture photography of the fluorescent screen has a very definite place in this type of diagnosis.

The author's apparatus consists of a table, the lower portion of which is built into a light-tight compartment, lead-lined and containing a fluorescent screen built into the table level, above which is a stationary grid. A 45-degree-angle front-surface mirror is mounted in the compartment below, from which the image on the fluoroscopic screen is reflected to the camera. The person giving the injection is protected by a lead shield with a small opening for the injection procedure and a lead glass window for observation. A window is provided in the light-tight compartment under the table, through which the fluorescent screen may be observed.

Above the table is a rotating anode tube with fine

focus, energized by a constant potential and capable of delivering 90 kv.p. at 80 ma. for eight seconds. (This constitutes the limit of exposure of 50 r at 65-cm. focal skin distance.)

A specially constructed camera is used with f.85 lens, the shutter opening throughout 270 degrees and closed throughout 90 degrees. The tube is automatically energized throughout approximately three-quarters of the open phase, thus avoiding lag of the fluoroscopic screen between frames and giving a sharper image. Thirty-five-millimeter green sensitized film is used (Agfa).

A special copying apparatus is described, allowing reproduction of the film (originally run between 12 and 24 frames per second). Each frame can be reproduced one to twenty times, thus slowing the motion when the image is projected on a screen.

Cardiac catheterization may be observed accurately through the window, and by placing a cassette in the tray originally holding the lead glass, individual films of the catheter may be made as it progresses through the various positions. For these individual exposures, the factors are 80 kv. and 20 ma., with 1 mm. of aluminum filtration.

Angiocardiography is done after testing for iodine sensitivity two days previous to the examination. Thirty to 60 c.c. of joduron (70 per cent) or perabrodil (80 per cent) is injected into the antecubital vein, the amount depending on the size and age of the patient. The motion picture run on average patients is approximately 18 frames per second. Oxygen is given if there is any suggestion of cardiac arrest or other shock symptoms. Four hundred thousand to 600,000 units of penicillin are given daily for two days following the procedure.

The author hopes to construct a new apparatus allowing him to use greater penetration and plans to attempt photographing in 2 planes to produce stereoscopic effects.

[To those who are planning to do motion-picture angiocardiography, even though they do not read German, the illustrations of the construction of the table and the apparatus assembled will be of very definite interest.—E. W. S.]

Twelve illustrations, including a series of cineroentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Patent Ductus Arteriosus: Diagnosis by Introduction of Catheter through Ductus from Pulmonary Artery into Aorta. Johan Karnell, Gunnar Jönsson, and Bror B. Brodén. Acta radiol. **33:** 405–411, May 1950.

The authors' method of diagnosing patent ductus arteriosus involves direct catheterization of the ductus itself. This was attempted in 10 cases and in 4 it was possible to push the catheter from the pulmonary artery through the patent ductus into the aorta and establish the diagnosis roentgenologically. In all 4 cases the opening communication between the pulmonary artery and the aorta was a wide one. The authors state that only a few attempts should be made to pass the catheter through the suspected patent ductus. If success is not achieved after a few minutes, the attempt should be abandoned.

In the cases where the communication between the pulmonary artery and thoracic aorta *via* the patent ductus was established by this method, radiopaque material was injected, but in no case was it possible to visualize the ductus completely and in detail with the opaque substance.

Inasmuch as the heart is catheterized for measurement of blood gases and pressure, the attempt to pass the catheter through a patent ductus does not involve any additional hardship or inconvenience to the patient.

Six roentgenograms.

NORMAN GLAZER, M.D.
Cleveland City Hospital

Coarctation of the Aorta of Adult Type Associated with Acquired Aortic Stenosis. Robert L. Gilbert, James J. Riordan, and James P. Murphy. J. Missouri State M. A. **47:** 333–335, May 1950.

A single case is presented, probably unique, of coarctation of the aorta in association with calcareous stenosis of the aortic valve. Before the stenosis became pronounced, hypertension was present in the arms, but at the time of hospital admission the blood pressure was 120/80. The patient was in mild cardiac failure, which may account for this in part. The diagnosis of aortic stenosis was based on the classical murmur and thrill, together with the roentgen demonstration of calcium deposits in all three valve leaflets. The coarctation was diagnosed on the basis of rib notching and failure to obtain blood pressure readings in the legs. Laminagrams made in the left anterior oblique projection were said to show the constriction, but this is not clear in the reproduction.

This is an interesting combination of lesions, the acquired aortic stenosis preventing the usual outcome of the congenital coarctation (cerebral hemorrhage or heart failure from hypertension). At the age of fifty-two the patient's heart did not appear to be enlarged except for some left ventricular hypertrophy.

Three roentgenograms; 1 electrocardiogram.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Coronary Arteriography in the Intact Dog. Felix Pearl, Meyer Friedman, Norman Gray, and Bruce Friedman. Circulation **1:** 1188–1192, May 1950.

The authors describe a method whereby the coronary circulation of dogs can be consistently demonstrated roentgenologically by the use of small amounts (approximately 4 c.c.) of 70 per cent diodrast injected through a specially devised radiopaque nylon catheter which is passed to the aortic sinus through a peripheral artery. Electrocardiograms taken during the procedure were normal. The aortic valves of two excised hearts previously subjected to forceful trauma by the catheter showed no evidence of injury. The most satisfactory pictures are obtained by lateral exposures.

Four characteristic arteriograms are reproduced, showing coronary arteries, the aortic valve cusps, and the proximal aorta.

C. R. PERRYMAN, M.D.
Baton Rouge, La.

THE DIGESTIVE SYSTEM

Radiographic Diagnosis of Polypoid Lesions of the Digestive Tract. William M. Kitchen and Everett R. Deweese. South. M. J. **43:** 446–448, May 1950.

The authors point out the importance, and sometimes the difficulty, of making the radiologic diagnosis of

polypoid lesions of the various portions of the gastrointestinal tract. They emphasize the value of adequate preparation for study, careful fluoroscopy with the use of spot films, and adequate film coverage. They make at least two complete double-contrast studies on each patient. Re-examination of all questionable findings is urged. The results of two years experience are summarized.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

Use of Procaine in the Examination of the Stomach and Duodenum. A. Oliveri and A. Oranger. Radiol. med. (Milan) **36:** 366–375, May 1950. (In Italian)

Radiologists have used atropine or belladonna for many years in an attempt to relieve pylorospasm and other spastic conditions of the gastro-intestinal tract. It is well known that the effect of these drugs is not too reliable, and for that reason, other drugs have been investigated by a number of research workers. The results were not conclusive, however, and until 1943 atropine was still regarded as the antispasmodic of choice.

In 1943, Porcher and his co-workers reported that pylorospasm could be easily overcome by the injection of morphine ten minutes before the administration of barium (Porcher, Lefebvre, and Boudaghian: J. de radiol. et d'électrol **25:** 238, 1942–43). Porcher also observed that gastric peristalsis was increased by the injection of morphine. This work has been confirmed by many other investigators, and it has also been shown that similar results can be obtained by the hypodermic injection of morphine with atropine, by the hypodermic injection of histamine, and by the use of apomorphine or ipecac. Although these drugs have different effects upon the stomach, their end-result is the disappearance of pylorospasm, so that the barium pours through the pylorus at a rate faster than normal.

Oliveri and Oranger have employed procaine by mouth, giving a solution of 1 per cent of procaine (100 c.c.) the night before and a solution of 2 per cent of procaine (50 c.c.) two hours before the examination. They claim that by means of such a procedure the examination of the stomach and of the duodenum is greatly facilitated. The spasm of smooth muscle is relaxed, and one is able to distinguish between spastic and cicatricial deformities of the stomach and of the duodenal cap. They also observed that in ulcer patients the characteristic ulcer pains disappear immediately following the administration of procaine.

[In spite of the apparent antispasmodic effect of procaine, the abstracter believes that such a method should not be employed without taking into consideration the possible dangers of procaine reactions, especially in view of the rather high dosage recommended by the authors.—C. G.]

Twelve roentgenograms.

C. GIANTURCO, M.D.
Urbana, Ill.

The Large Gastric Ulcer. A. W. Branwood. Edinburgh M. J. **57:** 234–242, June 1950.

In a series of 537 peptic ulcers seen in an Edinburgh hospital, 435 were duodenal ulcers and 102 gastric, a ratio of 4.2:1. Five types of gastric ulcer may be recognized radiologically: (1) mucosal erosions, (2) so-called callous or penetrating ulcers with deep craters, (3) ulcers perforating into the general peritoneal cavity or other structures, (4) malignant ulcers, (5) ulcerating benign tumors. Only the callous or penetrating ulcer, the malignant ulcer, and perhaps the benign tumor which has undergone ulceration need be included in the present discussion.

Most authors state that the average size of gastric ulcers is 1 to 1.5 cm. in diameter. In the present series, 57 ulcers (55.8 per cent) measured more than 2.5 cm. The ratio of males to females in the entire gastric ulcer group was 2.9:1, while in the large ulcer group it was 3.3:1. The average age for the total group was fifty-nine years; in the patients with large gastric ulcers the ages were rather lower. The average duration of symptoms in the patients with large gastric ulcers was shorter than in those with small ulcers. None of the 45 patients with small ulcers had coincidental disease. Two of the patients with large gastric ulcers had active pulmonary tuberculosis; 2 had syphilis; 1, a well-marked mitral stenosis; 1, aortic incompetence; 1, hypertension. Hypochlorhydria was present in 92.9 per cent of the cases of large ulcer. "Compared with the gastric analysis of patients with small ulcer, this hypochlorhydria is statistically, and should be clinically, significant."

Site: The simple gastric ulcer shows a marked predilection for the lesser curvature. In the author's series, 45 of the small ulcers were found on the lesser curvature. Of the large ulcers, 51 were located on the lesser curvature, 3 on the greater curvature, and 3 near the pylorus.

Shape: The penetrating simple ulcer produces a crater or niche which projects outward from the gastric curvature. The swollen mucosa at the periphery of the ulcer forms an areolar, halo, or ring shadow around the niche. The malignant ulcer may present as a small niche without the surrounding induration of the simple ulcer, or, more commonly, as a large, shallow, irregular crater on a plateau surface. It seldom projects out from the natural gastric contour. The shadow of this malignant ulcer produces a concave-convex defect which resembles a lens, the convexity directed toward the stomach wall and the concavity inward (the meniscus sign of Carman). Forty-five of the large ulcers in the present series were considered, on the basis of their roentgenologic appearance, to be benign. The remaining 12 ulcers, by their shape, suggested a malignant growth, but at operation all were found to be benign. The shape of all the small ulcers indicated their innocent nature.

Deformity of the Stomach: Deformities of the pyloric antrum, or, indeed, of any part of the stomach, due to scar tissue or spasm, are encountered commonly in gastric ulcer. Twenty-four of the patients with large ulcers showed evidence of spasmodic deformity of the body of the stomach, while 3 had spastic deformities of the pylorus. No associated alterations in gastric contour were seen in the remaining 30 cases. All 45 patients with small ulcers showed spastic deformity.

Tenderness: Tenderness over the area of ulceration is an important radiologic sign of benign active ulcer. Malignant ulcers are not usually tender. Tenderness was not a noticeable feature in the radiologic examination of the patients with large ulcers in this series.

Peristalsis: Hypoperistalsis of the stomach is often observed in association with gastric ulcer. The induration at the site of a chronic ulcer interferes with the gastric motility and the peristaltic waves are seen to become submerged at the site of the lesion and then re-

appear on the other side of the ulcerated area. The larger the ulcer, the greater is this area of peristaltic inactivity. In carcinomatous ulceration the peristalsis is also absent. In rare cases, however, the peristalsis may be exaggerated, irregular, or even antiperistalsis may occur. None of the patients in this series were examined fluoroscopically by the author and no information on peristaltic activity was recorded.

Mucosal Pattern: The appearance of the mucosal folds is important in differentiating malignant from simple ulceration. In carcinomatous ulcers the mucosa may be atrophied, with disappearance of the folds, or the rugae may be prominent and irregular. Whether the rugae are atrophied or hypertrophied, there is always interference with their natural pattern in malignant ulcer. In simple ulceration the mucosal folds may be hypertrophied and are seen to converge toward the ulcer crater. Forty-five of the large gastric ulcers showed a mucosal pattern suggestive of simple ulceration. All 45 cases of small gastric ulcer had the typical converging mucosa.

Evidence of healing is also an important point in the differentiation of benign from malignant ulcers. In 36 of the patients with large gastric ulcers and in 45 with small ulcers, evidence of healing was apparent fourteen days after the beginning of medical treatment. After four weeks of medical treatment, definite signs of healing were demonstrable in the majority of cases in both groups.

Results: Fourteen patients in the large ulcer group underwent gastric resection, 12 in whom cancer was suspected and 2 because of failure of previous medical treatment and the gross size of the ulcer. All made a good recovery. Seven patients died from various causes (perforation, 1; massive hematemesis 4; cerebral hemorrhage, 1; pulmonary embolus, 1); none showed any malignant change in the ulcer. None of the patients with small ulcers died.

Five tables.

X-Ray Differentiation Between Benign and Malignant Gastric Lesions. Gerhart S. Schwarz. Gastroenterology **15:** 67–74, May 1950.

Reviewing 1,327 consecutive roentgen gastric examinations on 1,079 patients, the author divided the positive reports into three groups: (1) those in which a definite diagnosis of a malignant lesion or probable malignant lesion was made; (2) those diagnosed possibly malignant but probably benign; (3) those diagnosed definitely benign. Excluding 72 reports of hernia, diverticulum, congenital anomaly, surgical changes, gastritis, foreign body, displacement by adjacent structures, and all lesions within the pyloric canal, 53 remained with a roentgen diagnosis of a gastric lesion. In 26 of these, repeat examinations were made. Thirteen lesions were termed malignant, 13 "benign or malignant," and 27 benign. A total of 38 were adequately followed.

Of the 13 cases termed malignant, 5 were proved to be so histologically, and 5 were presumed malignant on the basis of the clinical events and lethal course; 1 was shown not to be malignant histologically after gastric resection; and 2 were inadequately followed.

Of the 13 termed "benign or malignant," 2 were proved histologically to be malignant; in 5 there was no histologic evidence of malignancy after subtotal resection; 6 were inadequately followed.

Of the 27 lesions termed benign, 5 were subjected to surgery but no evidence of malignancy was found; 15 were proved benign by subsequent clinical events; 7 were inadequately followed.

In three instances the diagnosis was changed to "malignant" on second examination, replacing an original diagnosis of "benign or malignant" or normal. One of these cases was proved to be malignant histologically. In 48 cases the prominent roentgen sign was ulcer crater or antral deformity, with 21 showing both. With few exceptions, the usual signs of advanced malignancy were not observed in this series and radiologically the cases would be classified as "early." Only 1 of 7 lesions proved malignant histologically was resectable.

A glossary of terminology for roentgen reports which may permit more accurate expression of impressions about gastric lesions is included.

Two tables. BERNARD S. KALAYJIAN, M.D.
Detroit Mich.

The Relationship of Gastric Ulcer to Gastric Cancer (Panel Discussion). George T. Pack, Moderator. Cancer **3:** 515–552, May 1950.

This panel discussion was presented at the Annual Scientific Session of the James Ewing Society in January 1949. The participants were: Dr. Edward B. Benedict, Massachusetts General Hospital, Boston, Mass.; Dr. Mandred W. Comfort, Mayo Clinic, Rochester, Minn.; Dr. Ross Golden and Dr. Arthur Purdy Stout, College of Physicians and Surgeons, Columbia University, New York; Dr. George K. Higgins, New York Medical College; Dr. J. William Hinton, Post-Graduate Medical School of New York University; Dr. Sara M. Jordan, The Lahey Clinic, Boston, Mass.; Dr. John S. LaDue, Dr. Gordon McNeer, and Dr. George T. Pack, Memorial Hospital, New York; Dr. Marcy L. Sussman, Mount Sinai Hospital, New York. Remarks are also included by Dr. Morris K. Barrett, Dr. Harry Hauser, Dr. John Long, Dr. Herbert Willy Meyer, Dr. Isabel M. Scharnagel, Dr. Robert Sherman, Dr. Harold Stewart, and Dr. Allen O. Whipple.

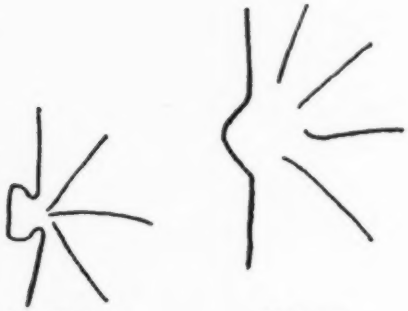
Forty-five questions relating to the diagnostic and etiologic relationship between gastric ulcer and gastric cancer were presented. Considerable discussion and difference of opinion were brought forth on questions regarding the significance of the size of a gastric ulcer and its location for the diagnosis of benignity or malignancy. The discussants were unanimous in believing that an ulcerating lesion on the greater curvature of the stomach was most certainly to be considered as malignant.

In reply to a question as to indications for radiographic investigation of the stomach, Dr. Golden stated that any symptoms referable to the stomach require radiographic examination. Dr. Sussman described his technic for roentgen examination of the stomach.

In answer to the question as to the importance and significance of the meniscus sign in the roentgen-ray diagnosis of gastric cancer, Dr. Comfort answered that it was his belief that it is the one sign that almost certainly insures malignancy, if properly interpreted. Dr. Sussman, in discussing the important sources of error in the detection of cancer of the stomach by roentgen methods, expressed the opinion that the most difficult problem lies in the differentiation of benign and malignant gastric ulcers which have relatively little infiltration around the wall. It is exceedingly difficult to identify a carcinoma that is localized to the immediate wall of the ulcer. Likewise it is difficult to make the

diagnosis of benignity in the case of a large callous ulcer, in which the wall is so thickened and indurated that it simulates carcinoma.

The discussants were asked to summarize the roentgenologic features of an ulcer that favor the odds that the lesion is benign or malignant. Dr. Golden illustrated his reply to this question by a diagram showing the typical contours of benign peptic ulcer and ulcerating carcinoma. The benign ulcer is deep in relation



Benign Malignant

to its width. The typical ulcer of carcinoma is flat and saucer-like and the base is wider than the apex. When ulcer craters fill in under treatment, the benign ulcer diminishes in depth and in width at the same time. The ulcerating carcinoma may fill in, but it diminishes in depth much more than it does in transverse diameter. The mucosal folds in ulcerating carcinoma often point to the crater, but they usually do not reach it. Again, there are exceptions to this general rule. When carcinoma begins to develop in the mucous membrane around a benign ulcer, the mucosal folds may be obliterated. They do not run into the crater as they do with benign ulcer, or the folds, as they approach, will become wider than the folds farther back.

Dr. Hauser mentioned that he had noted that in carcinomatous ulcer the crater is triangular in some cases. Dr. Sherman warned the radiologist to be extremely cautious in expressing an opinion concerning the etiology of an ulcerating lesion in the stomach upon the basis of a single examination.

The clinical points of distinction between gastric cancer and gastric ulcer, the gastroscopic differentiation between these two lesions, and the role of exfoliative cytology studies are well covered, and the indications for medical treatment of an ulcerating lesion in the stomach are discussed. In answer to the question "Does roentgen-ray evidence of healing or diminution in the size of the lesion assure its benignancy?" Dr. Sussman stated that carcinomatous ulcers may become smaller. In his experience he has never seen one that has healed completely. Dr. Golden thinks that failure of the ulcer to diminish in size should be taken as strong evidence in favor of carcinoma.

The questions as to how long it is safe to pursue medical treatment of an ulcer of the stomach, and the indications for operative intervention for ulcerating lesions of the stomach are discussed.

Eleven figures, including 8 roentgenograms; 2 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Pedunculated Papilloma of Stomach. Arthur J. Atkinson, Mark C. Wheelock, and Richard O. Mossey. Gastroenterology **15:** 356–358, June 1950.

The authors report briefly a case of benign gastric polyp with intermittent prolapse into the duodenum. Radiologic examination, including spot films, showed a constant deformity of the antrum of the stomach accompanied by an inconstant deformity of the duodenal bulb. The diagnosis was proved at operation.

Two roentgenograms.

Roentgen Diagnosis of Inflammatory Conditions of the Small Bowel. R. Prévôt. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 547–563, March 1950. (In German)

Acute enteritis is not, at the present time, very often studied by x-rays. Hypertonicity may be seen, however, with moderate segmentation, without change in the mucosal pattern except that due to edema, namely, broadening of the folds and slight narrowing of the lumen.

Subacute and chronic enteritis of the simple nonspecific form is mentioned very little, particularly in the American literature. In the earlier stages it is considered as a functional condition, later showing mucosal swelling with increase of secretion causing a flocculation of the barium.

Subacute and chronic enteritis show, in the earlier stages, a lack of the spiral pattern of the individual mucosal folds, which become more transverse. They are broader than normal and on palpation give an impression of stiffening. There are changes in the tone of the bowel and irregularities in filling, due to admixture of the barium with the increased amount of secretion. The intermediate stage shows mucosal swelling, a greater degree of stiffening of the wall, closer spacing of the exaggerated mucosal folds, and in some of the segments, induration. In the advanced stage there are areas of dilatation, lack of motility, often with considerable delay of passage, and atrophic changes of the mucosal pattern.

Regional ileitis may involve large or small areas. It is associated with clinical evidence of abdominal inflammatory disease and is often difficult to differentiate from acute appendicitis. A palpable mass is often present with fever and diarrhea. Roentgenologically a local area may simulate an infiltrating tumor. Involvement may extend for 50 cm. or more and the areas are often sharply demarcated. The mucosal pattern is obliterated, in some places there is contraction, and in others prestenotic dilatation. In advanced areas of involvement the contraction may be great enough to cause ileus. Fistula formation between loops of bowel is not uncommon.

Non-sclerosing enteritis (Ross Golden) is found in girls between the ages of ten and twenty-five years. Right-sided pain with diarrhea is present but mucus and blood are seldom found in the stools. A diagnosis of appendicitis is often made in these cases. X-ray studies show narrowing of the lumen and a peculiar cobblestone pattern of the mucosa, due to thickening or polypoid-like changes. Sometimes one or more of these thickened loops are palpable.

Necrotizing enteritis was first recognized during World War I and believed to be on the basis of severe inflammatory changes, with poor dietary habits as a contributory cause. The colon may be involved as well as the small bowel. In the early stages, x-ray

studies show atonic ileus; later the mucosal pattern is distorted or obliterated, rigidity and induration occur, and there is delay in passage through the individual loops. Healing, however, occurs without permanent stenosis.

Tuberculous enteritis may be of either the ulcerative or hypertrophic form. Ulceration, infiltrated areas with polypoid formation, and hyperplasia involving individual loops, usually 2 to 5 cm. in length, are commonly seen. There is eccentric or circular constriction due to the hyperplasia, and in the later stages to scar formation. The mucosal pattern is disrupted or grossly irregular. Characteristically, areas of involvement alternate with fairly normal loops of bowel, the so-called "skip" areas. The terminal ileum is the region most frequently involved.

Typhoid and paratyphoid enteritis, while not often investigated by x-ray, show stiffness and irregularity of outline due to proliferation of the lymphoid follicles (Peyer's patches). Polypoid lesions are also demonstrated. The lower ileum shows the most frequent involvement.

Twenty-two roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Early Diagnosis of Strangulation Obstruction of the Small Intestine. Harold P. Totten. California Med. **72:** 365–368, May 1950.

The mortality of strangulation obstruction of the small intestine remains relatively high in spite of continued improvement in diagnosis and treatment. The author here attempts an evaluation of the early symptoms and signs, particularly as found in 100 cases at Los Angeles County Hospital from 1942 to 1948. In order to emphasize the specific diagnostic problem, obvious causes of strangulation obstruction, such as the various types of external hernia, are excluded from consideration, as are intussusception and mesenteric vascular occlusion, in which the clinical manifestations are different. The causes of strangulation in the present series, in order of frequency, are as follows: (1) adhesive band, postoperative; (2) volvulus due to mesenteric abnormality; (3) adhesions due to an intraperitoneal inflammatory process; (4) volvulus without apparent cause; (5) volvulus secondary to a tumor; (6) volvulus secondary to incarcerated external hernia; (7) miscellaneous causes. In the presence of other symptoms, an operative scar, particularly on the lower abdomen, should alert the examining physician to the possibility of strangulation obstruction.

Only 5 per cent of the patients were operated upon within twelve hours of onset of symptoms and 23 per cent in the first twenty-four hours.

The more prominent symptoms were pain, of maximum severity at a given site, present in 83 per cent; a characteristic attitude or position of attempted relief, 29 per cent; vomiting, 76 per cent; distention, 69 per cent; abdominal tenderness, 96 per cent, localized in 69 per cent. Muscular rigidity, a palpable mass, and characteristic disturbances of peristalsis were found with less consistency.

The roentgen findings are dependent on the rapidity of the process. The earliest findings were a faint or well defined shadow indicating a mass, isolated loops containing gas and fluid, and a diminution of large bowel gas.

Abdominal puncture was considered as a valuable diagnostic aid but was unnecessary in most cases.

The author believes that in early cases immediate surgery should be instituted, while in late cases more attention should be given to the general condition of the patient before operation is undertaken.

Two roentgenograms.

E. KASH ROSE, M.D.
Louisville, Ky.

Carcinoma of the Jejunum and Ileum Exclusive of Carcinoid Tumors. James E. Pridgen, Charles W. Mayo, and Malcolm B. Dockerty. Surg., Gynec. & Obst. **90:** 513–524, May 1950.

The 20-foot segment of jejunum and ileum gives rise to less than one-hundredth as many carcinomas as does the one foot segment of stomach.

A review of the literature shows the average age for jejunal and ileal carcinomas to be about fifty years, with males involved twice as frequently as females. The average duration of symptoms is fourteen months. Tumors are usually palpable and movable. Anemia, constipation, and weight loss are frequent symptoms, and localized referred back pain has been described. The lesion should be noted roentgenographically in approximately 85 per cent of the cases, with a higher percentage in the jejunum. Ring, polypoid, or ulcerating forms may be present. Primary resection is the treatment of choice although operative mortality is high.

The authors' series includes 44 jejunal tumors and 19 ileal tumors, all primary adenocarcinomas. These are classified in three groups according to the presenting picture, namely anemia, perforation, or obstruction, the last being the most common. Roentgen studies, made in 76 per cent of the cases, were diagnostic in 92 per cent. The majority of the jejunal lesions were in the upper one-third of the intestine, while the ileal lesions were predominantly in the lower third. The annular constricting type was the most frequent. In all types of lesions there was obstruction of varying degree, with dilatation and hypertrophy of the bowel wall above the lesion and relative constriction below it. Intussusception was most common with polypoid lesions. Thirty-four of the lesions were of Grades 3 and 4 (Broders), and these all involved the serosa. The higher the grade of malignancy the greater the incidence of node involvement. Distant metastases were rare.

Approximately 70 per cent of the cases were treated by wide resection of the lesion and regional nodes. Palliative procedures were performed in the majority of the others. The operative mortality was 16 per cent in the jejunal group and 37 per cent in the ileal group. A 24 per cent five-year survival was obtained. The average postoperative duration of life for jejunal lesions was 30.8 months and for ileal lesions, 34.8 months.

Seven illustrations; 7 tables.

JOHN M. PHILLIPS, M.D.
University of Pennsylvania

Adenocarcinoma of the Jejunum Diagnosed Preoperatively. A Case Report. Frederick Sargent, II, Tilden C. Everson, and Robert M. Kark. Gastroenterology **15:** 150–157, May 1950.

The authors report the case of a 65-year-old male with urinary retention, enlargement of the prostate, gross anemia, and central nervous system disturbance. Repeated upper and lower gastro-intestinal roentgen ex-

aminations were reported negative, despite continued evidence of occult blood in the stool. Pernicious anemia and bleeding from uremic ulceration were suspected. With conservative measures the patient improved, but five months later occult blood was still found in the stool. Upper and lower roentgen gastrointestinal studies were again negative. A small bowel barium study then showed an organic lesion of the jejunum just beyond the ligament of Treitz, diagnosed as carcinoma. At operation, an adenocarcinoma of the jejunum was found and resected successfully. The liver was not involved and aside from large firm nodes in the adjacent mesentery, no distant metastases were noted. Recovery was uneventful, and repeated examinations of the stools thereafter were negative for blood. A mild anemia and the central nervous system changes persisted. The patient had been followed for eight months.

The importance of doing small bowel studies when upper and lower gastro-intestinal studies are negative and occult blood is present in the stool is emphasized.

Three illustrations, including 1 roentgenogram.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Acute Volvulus of the Right Colon. Albert Courty. Masson & Cie., Paris, 1950. (In French)

Since the usual term "volvulus of the cecum" is too restrictive, the author has preferred to entitle this monograph "Acute Volvulus of the Right Colon". The ascending colon, a part of the transverse colon, and the terminal ileum may participate in the torsion. Rokitanski described the first case in 1841. Since then Scandinavian, German, French, Russian, and American publications have been devoted to the subject.

Volvulus of the right colon is said by various authors to cause 1.5 to 17 per cent of intestinal obstructions. The age group of twenty to forty years is most often affected. Seventy per cent of the patients are males. The disease is apparently more common in the Scandinavian countries, Russia, and Central Europe.

The essential predisposing factor is an abnormally mobile right colon. In the 20 mm. embryo the duodenum is fixed to the posterior abdominal wall. At the same time the cecum migrates beneath the right half of the liver, assuming its normal position in the eighth month of intra-uterine life. During descent the cecum rotates and by the fourth month after birth becomes fixed. Abnormal mobility of the right colon may result from an anomaly of migration, rotation, or fixation. Congenital bands, acquired adhesions, and other organic lesions act as precipitating factors. Adhesions are present in 30 per cent of the cases. Mesenteric cyst, tuberculous mesenteric nodes, pregnant uterus, neurinoma of the terminal ileum, and intestinal angioma have all been reported as leading to volvulus. Poor eating habits, straining, sudden movements, vomiting, and diarrhea have been noted as preceding an acute onset of symptoms.

Anatomic varieties include cecocolic volvulus, ileocolic volvulus, and volvulus of the longitudinal axis of the cecum and ascending colon. The last type has three subdivisions. In the first there is a fixed cecum with torsion above; in the second, the transverse colon is shorter or non-existent (volvulus of ectopic cecum); in the third, the cecum is in normal position, is not fixed, and rotates counterclockwise, and the ileocecal valve is rotated anteriorly and then to the right.

The anatomic lesion proper consists of enormous dilatation of the involved loop, and especially of the cecum. The thinning of the walls leads to peritoneal irritation. Perforation has been reported in as short a time as twenty-four hours and up to eighty hours.

Experiments utilizing an ileocolic phantom and studies in rabbits indicate that for volvulus to be produced the ileocecal valve should be continent, the ascending colon shortened, and the gaseous distention sufficient.

"Primary acute volvulus" and "secondary acute volvulus" are clinical designations for the types of pathogenetic syndromes, the latter being preferred to the often-used "chronic volvulus." The cases of secondary acute volvulus have episodes of pain, nausea, vomiting, and gaseous distention. After several hours or days the obstruction may relent spontaneously. Acute volvulus, primary or secondary, usually has a sudden onset. In about 10 per cent the onset may be torpid and progressive.

A dilated loop of bowel may form a visible arch or curve on the abdomen. Active peristalsis is lacking in 90 per cent of the cases. The suppleness of the abdominal wall varies with the degree of distention. The general condition of the patient is good during the first few hours.

Radiologic studies should include supine and upright views. Right and left decubitus positions, as well as the supine position, with horizontal beam may be utilized. An "immense balloon of gas" occupying a sometimes surprisingly large portion of the abdomen is seen. A fluid level may or may not be present. A barium enema may be given in doubtful cases; usually the flow of barium is stopped at the point of twisting of the bowel. Twenty-one roentgenograms illustrate the various positions and appearances with and without barium.

Under special clinical forms, volvulus of the right colon in pregnancy is emphasized. The enlarging uterus may push the mobile cecum upward, thus furthering the chance of obstruction. Pelvic and abdominal operations with postoperative intestinal atony may precipitate attacks. Also noted in association with volvulus are hernias (inguinal, umbilical), abdominal and pelvic tumors, and appendicitis. There may be multiple sites of volvulus.

Treatment is surgical. Spinal anesthesia is preferred, as the bowel regains tone quickly. The cecum is punctured to deflate it, then fixation and minimal cecostomy are performed. At times resection with ileotransverse colostomy is necessary. Antibiotics are administered.

In summary, this monograph presents rather a complete picture of a relatively uncommon but extremely interesting clinical syndrome.

Forty-five illustrations, including 21 roentgenograms.

CHARLES NICE, M.D.
University of Minnesota

Value of Tannic Acid Enema and Post-Evacuation Roentgenograms in Examination of the Colon. Arthur C. Christie, Fred O. Coe, Aubrey O. Hampton, and George M. Wyatt. Am. J. Roentgenol. **63:** 657–663, May 1950.

The authors feel that the use of tannic acid as advocated by Hamilton (Am. J. Roentgenol. **56:** 101, 1946) is a valuable addition to the previous methods of examination of the colon for the detection of polyps and

small carcinomas. The tannic acid serves three functions: (1) It is sufficiently irritating to stimulate contraction of the entire colon. (2) The solution is astringent and thereby inhibits the secretion of mucus. (3) It has the physical property of viscosity, which causes it to adhere to the bowel wall. These characteristics result in a uniform coating of barium over the entire contracted colon on the post-evacuation film. One gram of tannic acid is added to each 100 c.c. of barium water suspension.

In 4,225 barium enema examinations the authors found 40 polyps and 38 carcinomas of the colon. Of the polyps, 24 were benign and 10 malignant, microscopically. All were grossly benign. All patients operated upon with a roentgen diagnosis of polyp were found to have polyps at surgery.

The importance of preparation is again stressed. One to two ounces of castor oil about sixteen hours before examination and a cleansing enema about three hours before examination are recommended.

Since the routine addition of tannic acid to the barium enema solution and a more diligent search, the incidence of polyps has increased markedly in the authors' clinic. Air-contrast studies have failed to disclose any lesions which were not detected by other means but have added valuable confirmatory evidence.

Eight roentgenograms; 1 photograph.

P. B. LOCKHART, M.D.
Indiana University

Congenital Anomalies of the Gallbladder. Anatomic-Radiographic Picture and Its Clinical Significance. G. Muscettola. Ann. di radiol. diag. **22:** 231–275, 1950. (In Italian)

The author reports and illustrates numerous cases of anomalies of size, shape, and position of the gallbladder and also several cases of gallbladder diverticula and of double and partially duplicated gallbladder. The numerous illustrations make this article of considerable interest. The conclusion is reached that too little clinical importance has been attached to anomalous gallbladders and that some anomalies make the organ more prone to disease.

Twenty-three roentgenograms; 2 drawings.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Cholangiography Following Common Duct Drainage. Clarence E. Rees. California Med. **72:** 363–364, May 1950.

In a series of 197 patients with extrahepatic biliary disease the common duct was explored in 65. The indications were: (1) a history of colic and jaundice, (2) cholecystic disease with clinical jaundice or elevation of the icteric index, (3) jaundice not attributable to pancreatic carcinoma, and (4) recurring attacks of pancreatitis. In the absence of jaundice, operation was done when the relation of the size of stones to the cystic duct was compatible with their passage into the common duct, or when the common duct was dilated or thickened. Stones or debris were found in 34 cases, or 51 per cent.

Postoperative cholangiography was done in 60 of the author's cases. He does not make immediate cholangiograms routinely, since results are likely to be unsatisfactory because of the long exposure required with low-voltage portable equipment, the inability of the anesthetized patient to control breathing, and the presence of clots and air in the duct incident to manipulation. Delayed cholangiograms in ten to twelve days, however, are considered a "must." In 4 of the the 60 cases examined, residual stones were found to be present in the common duct.

The procedure is quite simple. Thirty minutes after administration of 1/6 grain of morphine, the patient is taken to the x-ray room and an opaque medium (diodrast) is injected through the T-tube. Anterior-posterior and lateral exposures are made.

E. KASH ROSE, M.D.
Louisville, Ky.

Intermittent and Perforating Cysts of the Pancreas. Walter Hess and Bernhard von Rütte. Schweiz. med. Wchnschr. **80:** 476–479, May 6, 1950. (In German)

The correct diagnosis of pancreatic cysts is often extremely difficult, because of the frequent change in the clinical picture. The cysts may suddenly disappear and recur intermittently, as happened in about 10 per cent of the 500 cases reported in the literature.

Three clinically different behavior types of pancreatic cysts may be recognized: (1) a single, sudden, definite disappearance with spontaneous healing; (2) a single disappearance with fatal outcome due to perforation (3) intermittent changes in the size of the cysts, with complete disappearance followed by an early recurrence, *i.e.*, the "truly intermittent pancreatic cyst."

Two of the authors' own cases are reported to illustrate the last two types.

A 73-year-old female was admitted to the hospital because of sudden pain in the left upper quadrant, signs of bowel obstruction, and cardiac decompensation. There was marked increase in the white cell count, the blood sugar was high, and the diastase content of the urine was increased. A diagnosis of pancreatic necrosis was made. Three weeks after admission a large tumor was felt in the left upper abdomen. A barium enema revealed a gastrocolic fistula. The patient died two months after admission and a large cyst on the caudal portion of the pancreas was found, with perforation into the transverse colon, stomach, and left pleural cavity.

The second patient was a 21-year-old woman who was admitted to the hospital because of pain in the upper abdomen radiating to the back and left shoulder. She was operated upon for gallstones and at the time of operation a normal pancreas was found. Within a period of two months after surgery a large tumor appeared in the left upper quadrant, with acute distress and a high diastase content of the urine. This cystic tumor disappeared three times within this observation period. A second operation was performed, and a large pancreatic cyst was found and drained. There was evidence of pancreatic necrosis. The fistula closed gradually and the patient made an uneventful recovery.

The authors, after considering their own experiences and the literature, come to the conclusion that the only logical explanation for the intermittent disappearance of pancreatic cysts is drainage through the pancreatic ducts or their branches. A perforation of the cyst into the peritoneum is almost always fatal. From a diagnostic point of view it is important to remember that a pancreatic cyst can temporarily disappear.

Four roentgenograms; 1 photograph; 3 tables.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Clinical and Roentgenological Findings in Steatorrhea of Varying Etiology. Chr. Juel Bjerkelund and Ole W. Husebye. Am. J. Digest. Dis. **17:** 139–149, May 1950.

Three main types of steatorrhea occur in adults in non-tropical countries: (1) pancreatogenic, (2) symptomatic, and (3) idiopathic.

Pancreatogenic steatorrhea is found in a number of diseases of the pancreas. Its characteristic signs arise from both external and internal dysfunction of the gland. Reduction in the external secretion may be disclosed by examining the duodenal juice, or more easily through clinical and laboratory evidence of faulty fat and protein digestion. Lack of lipase causes steatorrhea, while lack of trypsin causes creatorrhea and azotorrhea. Stool examination will reveal undigested fats and muscle fibers and an increased nitrogen content of the feces. Destruction of the islands of Langerhans will cause a hypoinsulinism with resulting hyperglycemia and glycosuria.

Symptomatic sprue is observed in Hodgkin's disease, lymphosarcoma and tuberculosis involving the mesentery, enterocolitis, and stricture of the gut. These conditions cause a destruction of the intestinal wall and a blockage of the lymphatics resulting in faulty fat absorption.

Idiopathic steatorrhea has a varied symptomatology. Asthenia, loss of weight, and abdominal symptoms are usually seen; there is steatorrhea without creatorrhea and azotorrhea, and the glucose tolerance curve is flat. It is often difficult to distinguish between symptomatic sprue and idiopathic steatorrhea.

In an attempt to discover whether or not there were any definable changes between the different types, the gastro-intestinal patterns were roentgenologically studied in 12 selected cases, 2 of pancreatic steatorrhea, 4 of symptomatic sprue, and 6 of idiopathic steatorrhea. The patient was given a glass of barium mixture, which was consumed in small sips over a period of thirty minutes, and was then examined at frequent intervals up to twenty-four hours.

In the cases of idiopathic steatorrhea, the roentgen examinations showed changes which are in accord with the findings of others in this type: dystonia, or variable caliber of the lumen; loss of variability in the mucosal pattern until eventually only circular folds are seen; sausage-like masses of barium in the intestine (the moulage sign), and flocculation of the opaque meal so that no mucosal relief can be seen.

Both of the cases of pancreatogenic steatorrhea showed relaxed jejunal loops, but little other change. The mucosal pattern was in general fairly normal, but in some places there were folds which were predominantly circular. Flocculation and the moulage sign were completely absent. These findings, it is believed, may constitute a principal distinction from idiopathic steatorrhea.

In symptomatic sprue, also, the roentgen picture may be of help in making the sometimes difficult differentiation from the idiopathic syndrome. One of the authors' cases showed dystonia, stasis, and changes in the mucosal pattern but no moulage sign. In another case the loops of intestine were constricted, with irregular stereotyped contours and coarse folds, and were nearly immovable.

Twenty-five roentgenograms; 2 tables.

JOSEPH T. DANZER, M.D.
Oil City, Penna.

HERNIA

Esophageal Hiatal Hernia. Louis H. Clerf, Thomas A. Shallow, F. Johnson Putney, and Kenneth E. Fry. J. A. M. A. **143:** 169–172, May 13, 1950.

Of 110 patients with esophageal hiatal hernia seen by the authors in a fifteen year period at Jefferson Hospital, Philadelphia, all but 3 had symptoms. The symptoms in order of frequency were dysphagia, pain (of various kinds and locations), indigestion, regurgitation, lodgment of food, hemorrhage, weakness, loss of weight, and hoarseness. Patients with a congenital shortening of the esophagus are not included in the series. No significant sex predilection was observed. Most of the patients were of middle age or beyond.

Both roentgen examination and esophagoscopy should be employed in the diagnosis of hernia, for one method supplements the other. In the present series the diagnosis was made by both means in 97 cases. In the remaining 13 the diagnosis was made by esophagoscopy alone. In no instance was the condition observed roentgenologically and not esophagoscopically. The roentgen interpretations in the 13 cases in which the lesions were diagnosed by esophagoscopy alone were: normal, 6; achalasia, 3; carcinoma, 2; and esophageal diverticulum, 2.

In the roentgen examination the esophagus and stomach must be viewed from many angles to determine the position of the lower end of the esophagus. Films made with the patient in the recumbent position were frequently necessary to outline the esophagogastric junction in relation to the diaphragm, for in reducible hernia the stomach may assume a thoracic position only when the patient is recumbent. The diagnosis becomes certain when gastric rugae are demonstrated above the diaphragm.

The esophagoscopic diagnosis was dependent on the demonstration of a portion of stomach above the diaphragm, relaxation of the esophageal mucosa, and absence of the normal "pinchcock" action at the hiatus.

As might be expected, esophagoscopy was superior to roentgenography in determining the presence of ulceration. Ulceration could be demonstrated in 39 patients by esophagoscopy; in only 5 was the diagnosis made roentgenologically.

In 35 patients the previous diagnosis was in error. These errors varied widely, ranging from coronary artery disease to foreign bodies in the esophagus. Twenty-seven of the incorrect diagnoses were of other lesions of the gastro-intestinal tract.

Conservative treatment (medical and mechanical) was carried out in 69 per cent and surgical treatment in 31 per cent of the cases in this series. Severe and recurrent hemorrhage and strangulation are definite indications for surgery, while large hernias and those which increase progressively probably should be operated upon also. Phrenic interruption may be done if the patient's condition does not permit actual repair of the diaphragm.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE MUSCULOSKELETAL SYSTEM

Paget's Disease. Synonym. Osteitis Deformans. H. A. Thomas Fairbank. J. Bone & Joint Surg. **32-B:** 253–265 May 1950.

This is another of the excellent series of articles "From an Atlas of General Affections of the Skeleton" appear-

ing in the British volume of the *Journal of Bone and Joint Surgery*. It is a good presentation of the subject of osteitis deformans, outlining the known facts about the condition, but offering no new theories or conclusions. Excluding the skull, the bone changes as seen roentgenologically are of four types: honey-combed or spongy, striated, dense, and grossly cystic. In the skull there are thickening of the outer table and irregular increased density.

Eleven cases of Paget's disease are described, one with osteoporosis circumscripta and one complicated by sarcoma.

A bibliography is included, as well as 19 roentgenograms and 2 photomicrographs.

PHILIP B. LOCKHART, M.D.
Indiana University

Neurofibromatosis. H. A. Thomas Fairbank. J. Bone & Joint Surg. **32-B:** 266–270, May 1950.

The author here presents a rather general discussion of neurofibromatosis as a part of his *Atlas* of skeletal diseases. The diagnosis is usually obvious clinically. The skin lesions are characteristic—café-au-lait spots and fibromata. Neurologic signs vary with the particular nerves involved. Skeletal changes are of two types. About one half of the patients have scoliosis and 7 per cent show bone changes which may be lytic or proliferative. The scoliosis is usually severe and progessive and occasionally produces a paraplegia.

The radiological appearance is that of cystic lesions in the long bones or spine, erosions of the cortex, or merely irregular sclerotic changes in the medullary or cortical portions of the long bones. In the presence of elephantiasis there may be increase in both density and length of the bones and diminution in caliber. The skeletal and cutaneous lesions may or may not be progressive.

Histologically the lesions vary from a collection of loose connective tissue containing irregularly arranged myelinated or amyelinated nerve fibers in the neuromas to jelly-like deposits produced by hyaline degeneration of the connective tissue in the cystic lesions. No explanation for the sclerotic appearance of some of the bone lesions is made. Some regard it as a late change of the processes already mentioned. The scoliosis may be due to actual cystic vertebral bodies with collapse but, in the absence of organic defect, is thought to be due to impaired muscle tone.

The author presents the history of a 21-year-old female in whom there was a rather curious lipping of the great trochanter and the ilia not previously described.

Three roentgenograms. J. S. SCOTT, M.D.
Indiana University

Radiographic Aspects of Congenital Osseous Syphilis. Henri Lefort. J. de radiol. et d'eléctrol. **31:** 261–267, 1950. (In French)

The first radiologic studies of congenital osseous syphilis were made by German authors: Holzknecht and Kienböck in 1900, Hochsinger in 1904, Fraenkel in 1911, Pick in 1919, and Wimberger in 1925. Since then numerous French and American writers have published their findings.

Spirochetes have been demonstrated in the periosteum, marrow, and cartilage after the fifth intra-uterine month in the syphilitic fetus. The osseous lesions may be manifest four to six weeks later, though in some cases they may not be demonstrable until several weeks after birth. The early lesions are rarely noted to appear after the age of six months. The long bones are most frequently involved; less commonly, the metacarpals, phalanges, and ribs. Involvement of the skull, jaw, and spine is exceptional in the infant. The lesions tend to affect all the long bones. Three types of early lesion are seen: osteochondritis, osteomyelitis and gummatous processes of the diaphyses, and periostitis.

There are three degrees of osteochondritis. In the first, the line of ossification is enlarged, dense, and irregular (saw-tooth), and may terminate in small spurs. In the second, a transparent band of osseous resorption is added. In the third, the metaphysis is almost entirely replaced by granulation tissue.

In syphilitic osteomyelitis, granulation tissue replaces a portion of the bone in the diaphyso-metaphyseal zone. This may be marginal or central. Fracture is rare.

The so-called periostitis is in reality a subperiostitis; the periosteum is itself intact. Beneath it there are several concentric layers of newly formed bone.

These lesions are usually treated in the first few months of life. From the age of six months to seven years few syphilitic osseous lesions are seen. From seven to fourteen years the "tardive" lesions appear. Osteochondritis is quite exceptional. Rarefying osteomyelitis is infrequent. Condensing osteomyelitis, accompanied by periostitis, is the usual picture; it is most frequently seen in the tibia (saber-shin). The cystic form is a rarity. Tardive lesions are seldom seen outside of the long bones. Hyperostosis or gumma formation may occur in the skull, jaw, or spine.

Differential diagnosis is discussed.

Fourteen roentgenograms. CHARLES NICE, M.D.
University of Minnesota

Osteolytic Bone Syphilis. Henry McGladdery. J. Bone & Joint Surg. **32-B:** 226–229, May 1950.

The author presents case histories of five young Oriental patients with destructive bone lesions. In two cases the clavicle was diseased, while in a third the humerus and first rib were involved additionally. In the fourth case the first metatarsal was fractured, while the tibia, fibula, and femur were fractured in the final case. All patients had positive serologic tests for syphilis. All improved after adequate antisyphilitic and orthopedic therapy.

The author indicates that acquired syphilis should be included in the differential diagnosis of osteolytic lesions of long bones. Standard descriptions have emphasized new bone formation rather than destruction.

Five roentgenograms; 2 photomicrographs.

DAVID C. GASTINEAU, M.D.
Indiana University

Diffuse Osteosclerosis in Aleukemic Myelosis. Wolfgang Hirsch. Fortschr. a d. Geb. d. Röntgenstrahlen **72:** 591–595, March 1950. (In German)

A 40-year-old mechanic was observed over a five-year period with gradually increasing generalized bone sclerosis. He was not acutely ill, but complained of vague digestive symptoms with lack of appetite, belching, constipation, and abdominal pain. No family history of a similar bone condition could be obtained. Physical examination was generally negative, except for considerable enlargement of the spleen; the liver

was normal as to size. The blood picture resembled that of an aleukemic leukemia, with immature forms of both red and white cells, associated with anemia. X-ray studies showed at first increased density in the bony portions of the ribs and later a generalized sclerotic process involving most of the skeletal bones with loss of medullary space but no broadening of the shafts, spontaneous fractures, or visible periosteal reaction.

The author regards the underlying pathology as an aplasia of the bone marrow with replacement by fibrous tissue and at a later stage as sclerotic changes, "etiology unknown." He considers the enlarged spleen as representing a compensatory mechanism. He mentions in differential diagnosis the primary osteosclerotic changes in osteopetrosis (Albers-Schönberg); the secondary osteosclerotic conditions incident to leukemia, polycythemia, lymphogranulomatosis, and Gaucher's disease; osteosclerotic conditions following alkaptonuria; fluorine, lead, phosporus, and arsenic poisoning; and metastatic bone invasion.

The more important features of myelosclerosis are summarized as follows: adult patient with no symptoms referable to the skeletal system and no tendency to spontaneous fractures; no obtainable family history of similar conditions; a blood picture simulating aleukemic leukemia; progressive sclerotic involvement of the general skeletal system (over a period of years); absence of broadening of the shaft, coarsening of the trabeculae or any visible periosteal reaction; enlargement of the spleen without tenderness to palpation.

[In this country we find that the greatest confusion exists between myelosclerosis and the leukemias, especially of the aleukemic variety, and consider myelosclerosis to be more benign in its course and prognosis. We do not feel that any problem of differential diagnosis should be offered by heavy metal poisonings, with the possible exception of fluorine poisoning, an occasional case of which may show a diffuse osteosclerosis. There is some doubt as to whether myelogenous leukemia shows this type of generalized sclerosing process.—E. W. S.]

Six roentgenograms. E. W. SPACKMAN, M.D.
Fort Worth, Texas

Osteoid-Osteoma. Francis M. McKeever. West J. Surg. **58:** 213–218, May 1950.

Osteoid osteoma is a benign tumor of bone which has been observed throughout the skeleton, with the exception of the skull and ribs. It is seen mainly between the ages of eleven and twenty-four, with extremes of two and fifty years.

Pain is the most important symptom, intermittent at first, later constant and severe. There is also point tenderness over the lesion and sometimes slight swelling but no redness. There is no fever or change in sedimentation rate, serology, or white cell count.

Roentgenographically a fairly diagnostic picture is obtained, varying with the duration of symptoms and the type of bone involved. In the earliest stages a small dense area is the only finding. This is rarely seen because early films are not obtained in most cases. Later the actual lesion is translucent but the surrounding bone becomes very dense. If the lesion involves the cortex of a long bone there will be subperiosteal bone formation. It may be necessary to take many oblique views in old cases to visualize the central nidus.

Pathologic examination shows a small circular lesion, 2 cm. or less in diameter, reddish brown, and well demarcated from the surrounding reactive bone. It is composed of osteoid tissue, condensed near the center to resemble true bone, with no signs of inflammatory reaction.

Treatment consists of removal of the entire nidus; the reactive bone need not be removed. Incomplete removal fails to relieve the symptoms but complete removal results in cure.

Five cases are reported in detail with good illustrations, including 10 roentgenograms.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

On Roentgenologically Non-Demonstrable Bone Metastases in Cancer of the Uterus. Juraj Körbler. Radiol. clin. **19:** 158–164, May 1950. (In German)

Reports in the literature as to the frequency of bone metastases vary widely but all emphasize the point that clinical symptoms may be present for a long time before lesions can be demonstrated on the roentgenogram. In many cases the primary lesion has been operated upon at a time when metastatic bone involvement was already present. The spongiosa can be totally destroyed without discovery of the process.

The author describes a typical example. A 37-year-old woman was treated with radium in May 1946 because of a beginning cancer of the cervix. Two years later, she complained of severe sciatic pains, which were completely relieved by snake venom injections. Metastatic spread to the spine could not be demonstrated roentgenographically. In May 1949, severe pains in the lumbar region developed. A roentgenogram of the lumbar spine was again negative. An intravenous pyelogram was suggestive of renal metastases.

The patient died a few days after the intravenous pyelogram was obtained. Autopsy revealed a metastatic bone lesion in the body of the third lumbar vertebra 1.5 cm. in diameter. Metastatic tumors were present in the right kidney and nodules were observed at the lower peritoneum and along the lymph vessels of the lower pelvic region.

Two roentgenograms.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Experimental Scoliosis—the Role of the Epiphysis. I. William Nachlas and Jesse N. Borden. Surg., Gynec. & Obst. **90:** 672–680, June 1950.

The authors believe that asymmetric growth of the vertebral epiphyses is an important step in the production of scoliosis. They present several important facts and observations to support their belief. The development of a scoliotic deformity is limited to childhood, particularly in active growth years, and the deformity in children progresses even after deviating forces are altered. Unilateral forces applied to adults do not lead to the disfiguring deformities produced in children.

Studies of the behavior of the epiphyses of a large group of rachitic children have revealed several pertinent factors. Patients with bowlegs and active rickets were treated with vitamin D and though the rickets was cured roentgenographically, the deformities remained and, in some instances, tended to increase for a short time. This was attributed to the manner in which bone grows at the epiphysis. The curve of a bowleg is such that the epiphyses above and below the knee converge toward each other on the concave side

rather than being parallel. With corrective braces so that the apex of the curve was pulled toward a rigid longitudinal bar on the inner aspect of the limb, the epiphyseal cartilages became narrower on the convex side and broader on the concave side with a reduction of the epiphyseal cartilage tilting. Bone elongation proceeded in a direction that progressively straightened the extremity. When the extremity was straightened, the cartilage plates acquired their usual disk shape. Thus, when one edge of an epiphyseal cartilage is compressed, the direction of bone growth is changed as the plane of the plate is changed. The plane of the zone of provisional calcification probably constitutes the directing medium.

Applying the above principles to the epiphyses of the vertebrae, the authors produced experimental scoliosis in young growing dogs by stapling three vertebral bodies unilaterally, without positive compression, and allowing the compression force to develop by the elongation of the growing spine against the restraining effects of the staple. In none of the animals with experimental scoliosis was there x-ray evidence of disease or destruction. The changes in the spines paralleled those in adolescent scoliosis, with narrowing of the bony portion of the vertebral bodies and of the intervertebral cartilage on the concave side. The deformities were progressive, even after the staples were removed. In several there were actually compensatory curves in the thoracic spine.

On the principle that asymmetric growth of the vertebral epiphyses is an important factor in the production of idiopathic scoliosis, the authors believe that methods used in their experiment would permit the correction of scoliosis in properly selected cases. They substantiated their assumption in an additional group of animals in which a fixed lateral curvature was cured by applying operative growth control.

Sixteen illustrations, including 14 roentgenograms.

JOHN M. DENNIS, M.D.
University of Pennsylvania

The Ruptured Intervertebral Disc Problem in the Veteran. Gioacchino S. Parrella and Anthony Zovickian. Surgery **27:** 762–769, May 1950.

The authors report the study of 159 patients with low backache admitted to a Veterans Administration Hospital. Eighty-seven of the patients were suspected of having ruptured disks. Fifty were treated by operation. Thirty-three (66 per cent) of the patients operated upon gave a history of previous injury to the back. In about one-half of the cases (52 per cent), the onset of the symptoms was sudden and could be definitely connected with a single trauma. In half of the patients the chief complaint was sciatica; in the rest the complaints were equally divided between back pain alone and back pain associated with sciatica. Lumbar lordosis was absent in 74 per cent of the patients who came to operation and Lasègue's sign was present in 94 per cent of the cases. In addition, 70 per cent of the group presented a list.

Pantopaque myelography was done in all but 5 of the patients undergoing operation. In 12 of these the myelograms were indeterminate: 9 with ruptures of the fifth lumbar to the first sacral disk, 2 with ruptured disks at the fourth to fifth lumbar interspace, and 1 in whom exploration was negative. Of the 33 positive myelograms, only one proved to be false. Thus, there were 33 correct diagnoses, or 71 per cent. An indeterminate or negative myelogram did not necessarily exclude pathology in view of *bone fide* clinical signs.

Of the 50 patients operated upon, about 78 per cent had good to excellent results. An additional 19.1 per cent were improved. Conservative treatment was unsuccessful in 63 per cent of a series of 27 patients who were observed for an average period of 20.7 months. The results of re-exploration of ruptured disks were relatively unsuccessful.

Three tables.

RODERICK L. TONDREAU, M.D.
Lincoln, Nebr.

Familial Incidence of Cervical Ribs. Robert K. Purves and Paul H. Wedin. J. Thoracic Surg. **19:** 952–956, June 1950.

Although the occurrence of cervical ribs is relatively common, about 0.5 per cent, the familial tendency appears to be rare. The authors report on one family in which the mother and father each had one cervical rib, and 5 of their 10 living children had bilateral cervical ribs. Curiously these were the youngest of the family; the 5 older children did not have cervical ribs. All of the cases were asymptomatic. The children with the cervical ribs all had other minor spinal anomalies.

Seven roentgenograms.

HAROLD O. PETERSON, M.D.
University of Minnesota

Internal Rotation Dislocation of the Shoulder. Report of a Case. L. S. Michaelis. J. Bone & Joint Surg. **32-B:** 223–225, May 1950.

A woman of fifty-nine years, healthy and unusually muscular, fell on her outstretched left arm. There was immediate severe pain in the left shoulder and no movement of the arm was possible. Immediate roentgenograms, including stereoscopic views, were reported as negative.

The author first saw the patient four weeks after the accident. Pain and limitation of motion were still present. The left humerus was held in maximal adduction and internal rotation. The head was not palpated in its normal place nor anteriorly, and it was not present in either of the two typical positions of posterior dislocation. Closed reduction was accomplished, but redisplacement occurred within forty-eight hours. Open reduction was then performed. The head of the humerus was rotated inward nearly 90 degrees, and was locked at the posterior rim of the glenoid.

In the discussion, the author suggested that, since radiography cannot always be relied upon in these cases, the diagnosis be based on the clinical finding of locking of the limb in adduction and inward rotation.

One roentgenogram; 1 diagram.

W. L. BRIDGES, M.D.
Indiana University

Strains of the Ankle Joint. C. Somerville-Large. Irish J. M. Sc., pp. 225–228, May 1950.

The commonest injury to the ankle is the inversion twist, with the foot in plantar flexion. Interest in these ankle injuries centers around the fact that the upper articular surface of the astragalus is a little wider in front than behind, so that in dorsiflexion of the foot the wider part is engaged in the tibiofibular mortice and in plantar flexion the narrower portion. As to how the adjustment is made, the author found standard texts on anatomy either vague or actually in error. He be-

lieves that the fibula rotates slightly in ankle joint movement to adjust its articular surface to the outer articular surface of the astragalus. This in itself, however, is insufficient and some adjustment of the tibiofibular mortice must always be made to suit the widest section of the astragalus.

It is believed that the ligaments around the ankle joint show factors which have not been adequately stressed. Their arrangement is such that the lateral side is not well protected in the position of plantar flexion, accounting for the frequency of the inversion type of strain. The deltoid ligament, on the other hand, protects the ankle medially in all positions. From his consideration of these and other factors, the author concludes that in the normal ankle one would expect to find some tilting of the talus on forced inversion with the foot in moderate plantar flexion, when the angle between the calcaneofibular and talofibular ligaments is pointing downward. X-ray examination of the ankle joints of 21 persons with no history of injury showed this to be actually the case.

Tilting of the talus cannot then be regarded as reliable evidence of ligament rupture. In cases of severe tilting, the injury will involve the capsule between the calcaneofibular and anterior talofibular ligaments, or the anterior talofibular ligament itself.

One roentgenogram; 4 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Tarso-Epiphysial Aclasis. A Congenital Error of Epiphysial Development. David Trevor. J. Bone & Joint Surg. **32-B:** 204–213, May 1950.

The author defines tarso-epiphyseal aclasis as a congenital growth disorder of the tarsus and epiphyses, but he includes also similar cases involving the knee joint either alone or with ankle involvement. The essential feature is an overgrowth of the epiphyses on one side of a joint. Where two joints are involved, the overgrowth is on the same side in each.

Eight cases are reported here, 7 of them in boys. The age range was from nine months to ten years. Both knee and ankle were affected in 5 cases, the ankle alone in 1, and the knee alone in 2.

The overgrowth is not painful, but there is usually limitation of motion with valgus or varus deformity depending on the side of the joint involved. The radiographic findings are characteristic. The changes are confined to the epiphyses; the metaphysis is normal. In the case of the knee, there is enlargement of the femoral epiphysis and sometimes of the tibial epiphysis. The enlargement grows back toward the popliteal space above the epiphyseal line, extending also inward on the medial side and outward on the lateral side. The appearance suggests a mass of cartilaginous tissue containing several foci of ossification. In cases of involvement of the medial side of the ankle, the medial malleolus was found to be enlarged, and on the medial side of the talus there was an irregular surface growth extending medially. When the navicular and cuneiforms were affected, singly or together, the ossific nucleus appeared early; instead of one center, there were several. When the lesion involved the lateral side of the ankle, the radiographic findings were similar.

Treatment consists in removal of the projecting mass if this can be done without causing instability of the joint. When the outgrowth is extensive, its complete excision may involve stabilization of the joint. This should be undertaken only if fully justified by the severity of the deformity and is seldom indicated.

Nineteen roentgenograms; 1 photograph; 2 diagrams.

R. C. DATZMAN, M.D.
Indiana University

Osteochondritis of the Cuboid Associated with Tuberculosis of Adjacent Tarsal Bones. Report of a Case. F. Y. Khoo. J. Bone & Joint Surg. **32-B:** 230–232, May 1950.

A Chinese boy aged six years was seen for draining sinuses over the left neck, elbow, and dorsum of the left foot. The sinuses had been present for more than a year, having started as multiple nodules in the neck which subsequently ruptured. The clinical diagnosis was tuberculosis. Left foot radiographs showed moderate osteoporosis, but the cuboid showed disk-like flattening with some sclerosis and a sharp outline, suggesting osteochondritis.

Nine months later radiographs of the left foot showed that the cuboid had become larger and thicker. It remained flattened, sclerotic, and sharply outlined. There were patchy areas of destruction in the third cuneiform suggesting tuberculosis. Other tarsal bones remained osteoporotic and there was moderate soft-tissue swelling. Still later, further increase in the size and thickness of the cuboid was demonstrable; it was less dense than before and fairly sharp. There was more destruction of the third cuneiform, and the tarsal bones were more crowded together.

Radiographically there was little doubt as to the diagnosis of osteochondritis of the cuboid. The other lesions of the left foot, elbow, neck, and chest were regarded as tuberculous.

The author discusses, without definite conclusions, the possible relationship between osteochondritis and tuberculosis.

Six roentgenograms.

W. L. BRIDGES, M.D.
Indiana University

GYNECOLOGY AND OBSTETRICS

Hysterography in Cancer of the Corpus of the Uterus. Olof Norman. Acta radiol., Suppl. LXXIX, 1950.

The author undertook a study to determine the value of roentgen examination of the corpus of the uterus, believing that this method might be useful in the diagnosis and treatment of cancer of the corpus. A review of the literature revealed few authors in favor of this examination, since most of them considered it dangerous because of possible dissemination of tumor cells or infection intraperitoneally. The author's experience with 411 hysterographic examinations in 128 pathoanatomically verified cases of cancer of the corpus refutes the idea of spread of infection, though it is still too early to be sure about spread of tumor cells.

Hysterography was found to reveal a close correlation between the roentgen picture of cancer of the corpus and macroscopic findings at operation. Two main types were distinguished: the circumscribed type and the diffuse variety. The examination was also useful in the differentiation of cancer from many benign conditions, such as myoma, polyps, ovum, mole, placental rests, hyperplasia, specific and non-specific inflammatory processes, and radiation reaction. The diagnostic reliability was very high, 115 positive diagnoses being made in the 128 cases examined. In none of the re-

maining 13 cases were the lesions subsequently found to be malignant tumors. Of the cases diagnosed as malignant roentgenologically, 4 proved to be benign.

The practical value of hysterography in cancer of the corpus seems to be covered by the following observations:

1. Hysterography was found to be indicated in cases where curettage showed nothing pathological in spite of clinical symptoms of cancer. It also proved to be superior to intra-uterine instrumental palpation in locating tumors in patients referred for treatment after curettage.

2. Cervical involvement, seen in 33 patients in the present series, can also be demonstrated with a greater degree of certainty by hysterography than by other methods of clinical examination.

3. In clinically suspected cancer, hysterography proved an excellent method for detecting pathologic changes, including changes other than cancer. Roentgen control can also be used during and after treatment.

This monograph is well organized and excellent radiographic reproductions are used to demonstrate the various types of cases making up the series.

Eighty-seven roentgenograms; 8 photographs; 18 tables.

DONALD R. BRYANT, M.D.
The Henry Ford Hospital

Hysterosalpingography Followed by "Hydropertubation." Jan Maršálek. Schweiz. med. Wchnschr. **80:** 498–499, May 13, 1950. (In German)

The author describes a new method of hysterosalpingography which involves injection of a 20 per cent lipiodol solution followed by normal saline solution mixed with penicillin. He injects 8 c.c. of the lipiodol and then observes the filling of the uterus and tubes under a fluoroscope. If, after a second attempt with slight increase in pressure, the tubes cannot be visualized, about half of the injected material is withdrawn and 20 c.c. of normal saline solution containing 10,000 units of penicillin is administered.

In cases where the obstruction lies in the ampulla of the tubes, an attempt is made to move them mechanically with the help of a special rectal applicator consisting of wood with a lead marking on the inside for roentgenographic visualization. In some cases of atonic ampulla it was possible to squeeze the contrast medium into the abdominal cavity.

The mixture of lipiodol, normal saline solution, and penicillin produces typical "cloudy" shadows on the roentgenogram. In case of patency of the tubes, this mixture will be found in the Douglas' pouch in the lower peritoneum. The method permits demonstration of patent tubes even if a narrow lumen is present, because of the low viscosity of the contrast medium. It makes it possible also to diagnose periampullar adhesions and large hydrosalpinx. The examination can be conducted in one sitting. No embolisms or other harmful effects have been observed.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Hysterogram Diagnosis on the Basis of Models. Hans-Wolfgang Kayser. Fortschr. a. d. Geb. d. Röntgenstrahlen **72:** 600–606, March 1950. (In German)

Having injected the uterine cavity in operative and autopsy specimens with an opaque medium and placed the injected uterus in various positions and relationships to the bony pelvis, the author constructed a series of models showing the relationships of the x-ray beam and the position of the organ. Demonstrations were carried out simulating various conditions found in actual practice and certain errors in interpretation were observed which were readily shown by this means. The observations were compared with a series of hysterograms made on sterile women.

Exact alignment of the central ray with the object (uterus) and the film is stressed. Under actual working conditions on patients, however, it is not possible to have the axis of the uterus parallel to the film. One may therefore be misled because of the distortion and also because of the position of the organ. Thus, axial rotation may give an impression of deformity of the uterus, pressure from without, and maldevelopment. Anteflexion gives an impression of a narrower body, generally smaller uterus, and a longer cervical portion. Retroflexion gives an exactly opposite picture, *i.e.*, an apparently larger body, shorter cervix, and broadening of the upper border of the cavity. [The pictures would indicate that the plane between the upper border of the symphysis pubis and the sacral prominence is parallel to the film, but the article does not specifically mention this posture.]

Apparent deviations from normal position may be caused by variations in the thickness of the uterine muscle, intramural tumors, pressure from outside masses, and adhesions. A comparison of the hysterograms with the x-ray films of the models is held to be of considerable help in making an accurate diagnosis.

Sixteen illustrations, including 12 roentgenograms.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Roentgen Pelvimetry by Differential Divergent Distortion. Ivan Isaacs. Am. J. Roentgenol. **63:** 669–676, May 1950.

A method for roentgen pelvimetry is described, applicable to the measurement of the transverse diameter of the pelvic inlet and the interspinous diameter. The technic is not recommended for sagittal plane measurements. The measurements are based on the principle that when an object parallel to a film is roentgenographed, the magnification of its image varies inversely as the target-film distance provided the object-film distance is fixed. Thus by making two exposures at different known target-film distances, two distorted images of different size are produced. The author develops a formula which makes it possible to calculate the true size of the object from the size of the two distorted images without knowing the distances of the object from the film.

Two successive frontal films of the pelvis are taken by shifting the tube from a target-film distance of 25 to 40 inches. The transverse inlet and interspinous diameter are measured in millimeters on both films. From each pair of measurements the actual diameter is calculated by the following formula:

$$T = \frac{3Aa}{8A - 5a}$$

where

T = true measurement of diameter
A = measurement on 25-inch distance film
a = measurement on 40-inch distance film

A nomogram may be constructed eliminating the calculations.

The author presents experimental evidence to prove the accuracy of this method of pelvic measurement.

Four roentgenograms; 1 nomogram; 2 tables.

W. L. BRIDGES, M.D.
Indiana University

Prenatal Radiological Diagnosis of Hydrops Foetalis. Eric Samuel and Joel Cohen. Brit. J. Radiol. **23:** 225–230, April 1950.

After a discussion of the cause of hydrops foetalis the radiological signs are given as: (1) the "halo" sign, a double shadow about the cranial vault, (2) abnormal spinal curvature, usually straightening of the normal curves, (3) abnormal fetal position, "Buddha position" with the femora extended, legs flexed, spine straight, head extended, and (4) skeletal changes, the bones appearing denser than normal. No one of these signs is diagnostic, but a combination is suggestive.

The first three signs are due to the generalized edema of the fetal tissues. The apparent increase in bone density is secondary to changes in the bone marrow, but may be exaggerated by technical factors consequent to the increased soft-tissue density.

A case is reported.

Nine illustrations, including 6 roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Diagnosis of Hydrops Foetalis. J. L. Boldero and F. H. Kemp. Brit. J. Radiol. **23:** 219–224, April 1950.

The "halo" sign and the "Buddha" position as evidence of hydrops foetalis are briefly discussed. Neither is considered diagnostic. The authors list three factors which they regard as an adequate basis for the diagnosis: straightening of the fetal spine, radiographic evidence of hydramnios, and evidence of iso-immunization in the mother. Three cases showing these signs are presented. The straightening of the spine is due to the excess fluid in the fetal abdomen and thorax.

These signs are not always present in hydrops foetalis and a straightened spine may occur from other causes. Fifteen cases with evidence of iso-immunization of the mother were observed in which the fetus appeared normal.

Ten roentgenograms. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Female Pseudohermaphroditism with Hypoadrenia. Theodore C. Panos. Pediatrics **5:** 972–987, June 1950.

Two infants with true female pseudohermaphroditism and associated hypoadrenia are described. Both infants had a history of anorexia, weakness, vomiting, diarrhea, weight loss, emaciation, dehydration, and shock due to the hypoadrenia. Both had abnormalities of the external genitalia consisting in an enlarged clitoris and a "urinary meatus" situated along the under surface of the clitoris or the perineum. In each there was a bifid scrotal sac. Urethrocystoscopy revealed the presence of a urogenital sinus, bladder trigone of the female type, "prostatic urethra" containing a flattened verumontanum, and an elongated utricle. Injection of an opaque medium through the utricular slit resulted in definite colpohysterosalpingograms with some opaque material spilling into the peritoneal cavity. Exploratory laparotomy revealed normal female internal genitalia and the absence of male gonadal tissue.

The symptoms of adrenocortical insufficiency were relieved by the administration of sodium chloride alone or combined with desoxycorticosterone acetate.

Fifteen illustrations, including 4 roentgenograms; 1 table. HOWARD L. STEINBACH, M.D.
University of California

THE GENITO-URINARY SYSTEM

Preliminary Report on Urokon, a New Excretory Pyelographic Medium. Reed M. Nesbit and Jack Lapides. J. Urol. **63:** 1109–1112, June 1950.

A new radiopaque material for excretory pyelography is reported in this article, commercially designated as urokon sodium 30 per cent. It has the chemical structure sodium-3-acetylamino-2,4,6-triiodobenzoate. It contains 65.8 per cent iodine per molecule, which is a higher percentage of iodine than in the other contrast media (diodrast and neo-iopax) currently used for urographic purposes, and its toxicity is said to be lower.

The results in 500 patients examined with urokon were compared with those in another series of 200 patients studied with a 35 per cent solution of diodrast or 50 per cent solution of neo-iopax. The initial study was made with a 50 per cent solution of urokon; later a 30 per cent solution was used. This medium in 30 per cent solution produced fewer side reactions than any other compound used in this study. There was no essential difference in the quality of the pyelograms obtained with the three compounds.

Five pyelograms; 3 tables.

SHIH-CHANG HWANG, M.D.
University of Pennsylvania

Clinical Evaluation of Urokon in Pyelography. J. F. Richardson and D. K. Rose. J. Urol. **63:** 1113–1119, June 1950.

Richardson and Rose report a clinical evaluation of urokon (see previous abstract). The recommended technic for intravenous injection includes the use of a 24-gauge needle and a slow injection rate. The average optimal time is four minutes for 25 c.c. of 30 per cent urokon in an individual weighing 150 pounds. The reactions to the contrast medium varied mainly with the rate of injection. None were alarming or lasting. Arm pain was distinctly less than with neo-iopax and extravasation caused no untoward effect. Sixty-five per cent of the patients showed an average fall in blood pressure of 12 mm. mercury systolic, and 8 mm. mercury diastolic. Patients giving a history of allergy were found to have a higher incidence of untoward reactions.

The most satisfactory method of preparation of the patient was with castor oil and dehydration. There was no essential difference in the quality of pyelograms between neo-iopax and urokon, but the urokon seemed to be excreted more rapidly. In pyelograms obtained after very rapid injection, the visualization of the urinary structures was not as good as in those made following slower injection.

Urokon was also used in retrograde pyelography. No evidences of toxicity or irritation were noted. The new medium proved to be more miscible with urine than neo-iopax, skiodan, hippuran, or sodium bromide.

Two illustrations; 5 tables.

SHIH-CHANG HWANG, M.D.
University of Pennsylvania

The Renal Peristaltic Cycle and Neuromuscular Aspects of Renal Function and Their Relationship to Diseases of the Kidney. Bernard Hatz. Ann. Int. Med. **32:** 971–982, May 1950.

That the ureter exhibits peristaltic waves has been known for at least eighty years. It is not so well known that the kidney calyces themselves exhibit rhythmic peristaltic activity. The purpose of the present paper, with the aid of an illustrative case, is to focus attention on this phase of renal excretory function.

Pyeloscopic and pyelographic observations made with serial radiographs show the calyces to contract in succession from above downward. As soon as the superior calyx contracts, the sphincter at its neck relaxes, permitting the calyceal contents to be expelled into the pelvis. At the completion of this systole, the sphincter contracts, preventing regurgitation from the pelvis into the calyx. The next lower calyx then contracts and another cycle begins. As the lowermost calyceal systole is finished, the pelvis contracts, propagating its contents into the ureter and initiating a peristaltic wave which is transmitted down into the bladder.

The motor nerve supply of the calyx and pelvis appears to be derived from the vagus; the sphincter system is reciprocally innervated by the sympathetic.

Trauma, infection, or any local unphysiologic or pathologic condition, such as a small tumor, may result in an altered renal peristalsis. Thus, in a pyelitis there may be a spastic pelvis, more or less permanently contracted calyceal and pelvic sphincters, and a disordered peristalsis, which will disappear if the infection has not been too severe or long-continued.

There occurs, also, a syndrome of continued neuromuscular dysfunction, resulting in an achalasia of the sphincters, causing calyceal and pelvic stasis, eventual hydronephrosis, and an obstructive nephropathy associated with a definite clinical syndrome which has been described by Harris (Proc. Roy. Soc. Med. **28:** 1497, 1935) as "renal sympatheticotonia." The dysfunction is usually unilateral, associated with kidney or loin pain and costovertebral tenderness, with no demonstrable organic cause of obstruction. The achalasia has been temporarily relieved by eserine. Sympathectomy has produced more lasting results.

Roentgenographically, three stages may be demonstrated: (1) A stage of irritability or systole showing a small or contracted pelvis on the one side with evidence of delayed emptying. Here, pyelographic observations will demonstrate that eserine injection results in emptying the pelvis, with relief of pain. (2) Stage of exhaustion or diastole. The pelvis is now enlarged but still capable of contraction. (3) State of paralysis with long continued stasis, atony, and hydronephrosis.

The authors present a series of films representing an intravenous urogram study in a 54-year-old white male, demonstrating in principle the neuromuscular dysfunction described. The patient gave a past history of hematuria, but a urologic consultation with cystoscopic studies had revealed no organic pathology. The presence of hypertension indicated the possibility that a long continued dyskinesia and sphincter spasm may produce an obstructive nephropathy with a resultant hypertension on the Goldblatt kidney basis. It is suggested that the dyskinesia may be associated with renal artery spasm.

Fourteen roentgenograms.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Marked Renal Hematuria with Negative X-ray Findings. John A. Taylor. J. Urol. **63:** 997–1005, June 1950.

There is a small group of cases with hematuria which tax to the utmost the diagnostic acumen of the urologist. In general, these cases of unexplained bleeding can be divided into five groups, due respectively to changes in the blood vessels, infections, minute carcinomas, blood dyscrasias, and the nephritides.

Blood vessel changes are usually those of varices and angiomas, which in most instances are large enough to cause a filling defect in the pyelogram. Angiomas are more common than renal varices, almost three to one. *Infections* comprise chronic papillitis with or without ulceration; there may also be minute calcification at the site of the inflammation. Pyelitis granulosa and early tuberculosis must also be considered. The diagnosis of *carcinoma* will depend on a series of positive Papanicolaou stains, as x-ray findings are invariably negative; the possibility of false-positives must be clearly recognized. *Blood dyscrasias* may usually be diagnosed on the basis of laboratory tests, such as prothrombin activity. In the last group, *the nephritides*, those due to toxins must be considered, with carbon tetrachloride being the most common offender.

Five cases are presented: one classified as essential hematuria (unilateral bleeding of undetermined origin); another due to low prothrombin activity; another possibly due to amebiasis; and two due to carbon tetrachloride poisoning.

Accepted procedures of treatment are irrigation of the renal pelvis with 1 per cent silver nitrate and pelvic lavage; catheterization and pyelographic study alone may check the bleeding. The author feels that methylene blue by mouth or instillation of a 2 per cent solution has a tendency to arrest capillary bleeding, so that its use is recommended.

Thirteen roentgenograms.

JOHN M. PHILLIPS, M.D.
University of Pennsylvania

Postcaval Ureter. Report and Discussion of a Case with Successful Surgical Repair. Raymond O. Olson and George Austen, Jr. New England J. Med. **242:** 963–968, June 22, 1950.

Less than 40 cases of postcaval ureter have been recorded in the literature. The condition has been more frequently reported in the past ten years due to aroused clinical interest in this anomaly.

The authors' patient was a 26-year-old male who was admitted to a hospital for urologic study. He complained of fatigue, lassitude, and loss of stamina but had no urinary symptoms. Microscopic blood had been found in the urine previously, but the physical examination and urinary findings at that time were essentially negative. Retrograde pyelography now showed a normal left urinary tract. On the right side the pelvis and the upper third of the ureter were dilated with an abrupt termination of the dilatation at the lateral margin of the spine near the third lumbar vertebra. Oblique films showed the ureter to pass directly posteriorly and somewhat medially at this level and then proceed distally. In the anteroposterior view the distal ureter was seen over the center of the lower vertebral bodies. There was definite retention of contrast medium after thirty minutes on the right side. These findings led to the diagnosis of postcaval ureter on the right.

At operation, the condition was found as suggested by radiography and the ureter was reconstructed by resection of a small segment and anastomosis. One year after operation the patient was reported to be well and free of symptoms.

The authors review the literature on this condition and consider the embryology and the clinical aspects. It is frequently found that the postcaval portion of the ureter is the seat of a chronic inflammatory process with stricture formation. The etiologic factors involved are usually considered to be deviation of the ureter from its normal course, constriction between the vena cava and the aorta or vertebrae, the presence of a fixing lumbar vein, and renal ptosis.

Treatment is discussed at some length.

Three roentgenograms; 1 drawing.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

Meningeal Metastasis from a Carcinoma of the Prostate (Its Possible Mechanism of Production). A. de la Pena and A. Anselem. Urol. & Cutan. Rev. **54:** 262–266, May 1950.

An unusual case of presumed prostatic carcinoma is reported. No biopsy or necropsy specimen was available for confirmation, but the x-ray findings were typical. Cerebral symptoms appeared near the end of a course of roentgen therapy and led to lumbar puncture with discovery of large numbers of neoplastic cells free in the spinal fluid. When the tumor cells were found, therapy was discontinued, 7,000 r having been given to five areas (skin dose). Shortly after this the patient died.

Six phlebograms are presented to illustrate the connection between the pelvic veins and those of the vertebral plexus. They were made by injecting uroselectan B into either the deep or superficial dorsal vein of the penis. Definite anastomoses are visualized between the two systems of veins, confirming former work done on cadavers.

Seven roentgenograms; 3 photomicrographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

TECHNIC

A Method of Measuring Distances in Roentgen Fluoroscopy. T. Szenes. Radiol. clin. **19:** 178–183, May 1950. (In German)

Orthodiagrams may be obtained with ordinary fluoroscopic equipment by using the simple method described in this paper. The screen is fixed at double the distance of the supporting wall from the focus. A small lead marker is fastened on the wall behind the organ to be examined. The central ray is then focused first on one and then on the other side of the organ contour and the shadow projection of the marker for each position is indicated on the screen. The distance between the two points represents twice the actual diameter of the organ to be examined.

This method is particularly valuable in determining the true diameter of the aorta.

One diagram. EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Variable Scale for Measuring from Radiographs in Smith-Petersen Nailing. H. Jackson Burrows. J. Bone & Joint Surg. **32-B:** 273, May 1950.

The author describes and illustrates a milled, telescoping, graduated, rubber ruler previously presented with E. T. Baily (Lancet **1:** 980, 1939) for evaluating the true depth in centimeters of a hip-pinning guide recorded on a radiograph. It is suggested that the variable scale device would be more valuable in hip nailing for orthodesis than for the femoral neck fractures.

One illustration. E. H. PRICE, M.D.
Indiana University

ACCURACY OF ROENTGEN DIAGNOSIS

Specificity and Reliability of Roentgenographic Diagnosis. The Shattuck Lecture. Merrill C. Sosman. New England J. Med. **242:** 849–855, June 1, 1950.

The author attempts in this lecture to estimate the accuracy and trustworthiness of diagnosis made primarily by the roentgenologic method. His estimates are based not only upon his own experience of thirty years as a radiologist but also upon that of his colleagues both in roentgenology and the associated specialties.

In diseases of the lungs about 95 per cent of the lesions can be demonstrated, and in 75 to 80 per cent the identity of the lesion can be established with a high degree of accuracy. In the gastro-intestinal tract it is estimated that 80 to 85 per cent of the lesions can be demonstrated, and of these about 90 per cent can be correctly diagnosed. About 90 per cent of bone lesions are demonstrable and probably 90 per cent of these are correctly identified. In the genito-urinary tract the percentages are approximately the same. Routine roentgen examination gives localizing signs in almost half the intracranial tumors, and identifying evidence in a fourth. If the special procedures of ventriculography and angiography are added, well over 95 per cent of tumors and vascular lesions of the brain can be demonstrated, but still not more than a third can be identified with any degree of certainty. In investigations of the biliary tract, about 80 per cent of the gallbladders are demonstrated and about 99 per cent of all cases examined can be correctly diagnosed.

This presentation brings to the attention of the members of the profession the advantages and shortcomings of roentgenographic methods of examination and the acknowledgment that the procedures are not the last word in investigation of the patient, but it also points out the positive value of a negative examination.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

RADIOTHERAPY

Role of the Tumour Bed in the Treatment of Squamous-Cell Cancers by Irradiation. A. Glucksmann. J. Obst. & Gynaec. Brit. Emp. **57:** 322–327, June 1950.

Contrary to the commonly accepted view, the author does not believe that the tumor bed plays a decisive role in the response of squamous-cell carcinomas to radiation. He feels that radiocurable epitheliomas are distinguished from others mainly in their ability to

react to radiation with an increase in the extent and degree of differentiation, and that this capacity is inherent in the tumor cells, and cannot be induced by any stroma reaction. He shows examples of striking tumor change, with little change in the surrounding stroma, and *vice versa*. Cases with lymph node metastases prove incurable by irradiation not because of the particular stroma in which the tumor lies, but because the incurable tumors tend to involve the nodes earlier. Lymph node involvement by radiocurable tumors does not preclude successful radiotherapy, provided an adequate dose can be given.

Twenty-five photomicrographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Ineffectiveness of Radiation of Deep Seated Tumors and How to Overcome It. Nándor Kiss. Radiol. clin. 19: 174–178, May 1950. (In German)

Radiation therapy for superficial cancer is successful because a destructive dose can be delivered to the tumor itself and the rays are homogeneously distributed. The author believes that the reason why deep roentgen therapy is so frequently unsuccessful lies in the fact that not only is the intensity of the radiation diminished but the rate of absorption also is decreased, so that an inadequate dose is obtained.

It is therefore suggested the deep-seated tumors be made accessible by surgery and be directly irradiated. In animal experiments it has been shown that the serosa of the abdomen tolerates a single massive dose of 1,650 r with 33 r output per minute, while the skin tolerates only 1,000 r under the same circumstances, with a half-value layer of 2.0 mm. Cu.

Another method to avoid the decrease in dose due to a diminished absorption rate in the deeper layers is the use of multiple ports simultaneously.

No case reports are given to substantiate these statements.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Treatment of Far Advanced Malignancy. Report of Four Cases in Children. G. M. Tice. J. Kansas M. Soc. 51: 225–229, May 1950.

Four cases of advanced sarcoma in which radiation therapy produced ten- to seventeen-and-a-half-year cures are presented. All were considered too advanced for surgery; 2 had metastasized to the regional lymph nodes. Treatment was vigorous and resulted in various complications—esophageal stricture, local necrosis, loss of teeth, and diabetes insipidus, but all the patients are alive.

Fifteen illustrations.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Malignant Epithelial Tumors of the Skin of the Head and Neck. Grant W. Ward and James W. Hendrick. Am. J. Surg. 79: 771–786, June 1950.

Eight hundred and forty cases of epithelial skin cancer involving the head and neck are reviewed, with special emphasis on the location and clinical features. Early recognition and attention to premalignant lesions, as hyperkeratosis, moles, and warts, particularly in older patients, are important. The lesions are classified in three groups, (1) basal-cell epitheliomas, (2) squamous-cell epitheliomas, (3) adenocystic epitheliomas, and comparative results with various forms of treatment are given. Whether or not radiological or surgical methods are employed is not so important as is the thoroughness with which the particular form of therapy is administered. Biopsy is mandatory not only for diagnosis but for classification for treatment.

Results are uniformly good when the lesions are treated before they are too advanced. On the other hand, recurrences after inadequate therapy give poorer results even when the most radical measures are used.

Twenty-one photographs; 6 photomicrographs; 1 drawing.

DANIEL D. TALLEY III, M.D.
University of Pennsylvania

End Results of Radiotherapy of Cancer of the Tongue. Juliette Baud. Am. J. Roentgenol. 63: 701–711, May 1950.

This report from the Curie Foundation, Paris, includes the results of treatment of 1,055 cases of cancer of the tongue from 1919 to 1941. Three groups have been distinguished according to the site of the primary lesion: (*a*) epitheliomas of the anterior third (tip and under surface); (*b*) epitheliomas of the anterior two-thirds (dorsum and edges); (*c*) epitheliomas of the posterior third.

Treatment was by radium puncture with removable needles, either alone or in combination with radium molds, teleradium, roentgen irradiation, or block dissection of the neck. External radium and roentgen irradiation were also tried alone. Doses, calculated from Quimby's table for interstitial irradiation, varied from 6,000 gamma r for large tumors to 8,000 or sometimes 8,500 gamma r for small lesions.

Among 86 cases involving the tip and under surface of the anterior third of the tongue (*a*), in all stages, 15 per cent five-year cures were obtained. Of 638 patients with involvement of the edges and dorsum of the anterior two-thirds (*b*), 21 per cent were alive and well after five years. Of 331 patients in the group with lesions of the posterior third (*c*), 10 per cent were well after five years. In all groups curability varied indirectly with the size of the primary lesion, involvement of contiguous structures, and fixation of the tongue. For the whole series the cure rate was 40 to 50 per cent for tumors under 2.0 cm. in diameter, dropping to 17 to 22 per cent when the lesion measured 2 or 3 cm. Lymph node involvement made the prognosis much more grave, and when fixation of the nodes was present the number of cures was negligible.

The best over-all cure rate, 25 per cent, was obtained with radium puncture combined with block dissection of the neck. However, 21 per cent five-year cures were obtained in 175 cases where radium puncture was used alone. It would thus seem that very little has been gained by combining other forms of irradiation with interstitial radium.

Late recurrences were seen after six to twenty years in all locations. The recurrences were either local or local with node involvement but never in the nodes alone. The recurrences can often be successfully treated if localized to the tongue but almost never when nodes are involved.

D. E. VIVIAN, M.D.
Indiana University

End Results of Treatment of Cancer of the Tongue. Elis Berven. Am. J. Roentgenol. 63: 712–715, May 1950.

The author's report of results in cancer of the tongue covers two periods, 1921 to 1930 and 1931 to 1942. In

the first period, treatment consisted of surface application of radium tubes, interstitial radium needles, roentgen therapy, and teleradium to the node-bearing areas from small sources. Since 1931, the treatment has consisted in strict oral hygiene, teleradium therapy through five portals to the primary tumor and regional nodes, electrocoagulation of any remaining primary tumor two to three months following irradiation, and radical block dissection of the neck when clinical metastases exist. The total dose to the primary tumor is 5,000 to 5,500 gamma r, over fifteen to twenty days.

During the first period 178 cases were seen but 42 were too advanced for treatment and there were 9 deaths from causes other than cancer. During the second period 302 patients were seen but 35 were not treated and 25 died of causes other than cancer. In the "determinate groups" the five-year cure rate was 21.3 per cent (of 127 cases) for the first period and 31 per cent (of 242 cases) for the second period. If the patients dead of causes other than cancer are added, the five-year cure rate in the first period was 19.9 per cent as compared with 28.1 per cent in the second period. If all patients seen are considered, the five-year cure rate drops to 15.2 per cent in the first period and 24.8 per cent in the second period.

Factors affecting the cure rate adversely were advanced age (above sixty years), male sex, syphilis, location of the primary lesion in the base of the tongue, tumor greater than 3 cm. in diameter or invasion of contiguous structures, and clinical metastases.

Three tables.

D. E. VIVIAN, M.D.
Indiana University

End Results and Treatment of Cancer of the Tongue. B. W. Windeyer. Am. J. Roentgenol. **63:** 719–726, May 1950.

This report from the Middlesex Hospital in London covers the twelve-year period, 1931–42. During this time 243 patients from a group of 279 who were seen with cancer of the tongue were treated. The five-year cure rate for the treated determinate group, numbering 230, was 21.3 per cent. This included growths in all sites with and without metastases. Ten-year cures were obtained in 13.1 per cent of 181 cases.

Breaking down these results further, the five-year cure rate for cancer of the anterior two-thirds of the tongue was 29.6 per cent, for the posterior one-third 9.8 per cent, and for whole tongue involvement 7 per cent. When the lymph nodes were not involved, lesions of the anterior two-thirds of the tongue showed 44.2 per cent five-year cures as compared with 17.2 per cent for the posterior third. When node metastases were present, the five-year cures for lesions of the anterior two-thirds numbered 13.8 per cent as compared with 5.7 per cent for the posterior one third.

The great majority of primary lesions confined to the anterior two-thirds of the tongue were treated by radium or radon needle implants, teleradium being reserved for cleaning up lesions prior to implantation. In contrast, the posterior one-third lesions were treated mainly with teleradium alone, some residual ulcers or indurations being implanted with radium needles. Roentgen therapy has been discontinued for these lesions.

No specific treatment is given to the regional nodes if none are palpable, but frequent and regular follow-up is the rule on all such patients. If mobile nodes develop, a block dissection of the neck is done as soon as irradiation reaction subsides. This procedure was made routine after evaluating teleradium therapy of these cases. For fixed, inoperable nodes teleradium is the treatment of choice if they are "fairly localized," while roentgen therapy is used for more extensive involvement.

The latter portion of this report is devoted to a discussion of the technic involved in planar and volume implantation of radium as advocated by Paterson and Parker and used successfully by the author.

Five tables.

D. E. VIVIAN, M.D.
Indiana University

Technique and Results of Treatment of Cancer of the Tongue with a 10 Gram Radium Beam Unit. Constance A. P. Wood. Am. J. Roentgenol. **63:** 727–738 May 1950.

A detailed description of the technic used in treatment of carcinoma of the tongue by radium beam therapy is presented in this paper from the Radiotherapeutic Research Unit of the Medical Research Council, Hammersmith Hospital, London. The apparatus, a 10-gram radium source, and the factors of filtration, application, method of beam localization and direction, immobilization, depth determination, and other technical procedures are discussed. With the aid of a new device, the dose contour finder, and known isodose curves, the dosages to the skin, nodes and tumor are calculated for each patient. As far as possible, a homogeneous dose is delivered to the entire tumor-bearing area in an attempt to acquire equal and adequate doses to both the involved nodes and the primary tumor. A dosage graph is plotted for each patient and 6,000 gamma roentgens to the tumor area and nodes are delivered, when possible, in forty-two days.

The majority of the cases were treated only by external irradiation, although excision or radium needle implants were utilized in a few patients who disclosed evidence of residual tumor at the primary site.

During the course of treatment, a graph representing the response of the tumor, nodes, skin, and mucous membranes is kept. These graphs, incidentally, revealed no greater radioresistance of the involved nodes than demonstrated by the primary tumor.

A total of 182 unselected patients were treated; in many the advanced stage of the disease permitted only palliation. The site and extent of the lesions, sex and age distribution, duration of the disease, and incidence of node metastases are presented in graphic form.

The five-year cure rates were as follows: for all cases 26 per cent; for lesions on the anterior two-thirds of the tongue 27 per cent, and on the posterior third 18 per cent; for cases without node involvement 35 per cent, with node involvement 17 per cent; for lesions of less than 2 cm. diameter 45 per cent, 2 to 3 cm. 33 per cent, 3 to 4 cm. 35 per cent, more than 4 cm. 14 per cent.

The palliative effects were notable. Treated patients not only lived longer but their life was rendered more comfortable and free from pain.

The author notes that the five-year cure rate did not increase commensurately with the improved accuracy of directing and measuring the radiation to the tumor, and suggests, therefore, that the response is not entirely a factor of physical dosage.

Seventeen illustrations; 2 tables.

JOHN W. WILSON, M.D.
Indiana University

Choice of Treatment in Cancer of the Larynx, Year 1949. Daniel S. Cunning. Ann. Otol., Rhin. & Laryng. 59: 467–473, June 1950.

Once the diagnosis of cancer of the larynx is established, the choice of treatment is not clear-cut. Shall it be surgery or radiotherapy, or possibly a combination of both? Many factors must be considered: size and location of the growth, site of its origin, the mobility of the cords, degree of involvement and possible involvement of the nodes of the neck. The emotional and mental attitudes of the patient must also enter into the decision.

Present-day methods of radiotherapy stem largely from Coutard's protracted fractional dose technic. The author's patients are treated daily for a period of approximately six weeks. Two lateral fields are irradiated simultaneously. The preliminary x-ray beam is centered over the site of the tumor. The entire lesion, plus a margin of normal tissue, must be included within the treatment field. It has been found that 6,000 to 8,000 r are usually required to produce clinical cure of a squamous-cell epithelioma.

The radiotherapist treating laryngeal cancer must specialize in this field. He should be able to examine the larynx with a head and laryngeal mirror at frequent intervals during treatment, watching for edema and the expected pseudo-diphtheritic membrane.

The author presents the following indications for treatment: A small, early growth involving one cord, which is still freely movable, may be removed by biting it out with a cup forceps, through a laryngoscope, and fulgurating the base. For larger lesions, involving one cord but not extending into or across the anterior commissure, or not extending posteriorly further than the vocal process, with a freely movable cord and no subglottic extension, laryngofissure is the operation of choice. Radiotherapy in these two types of lesion is considered equally effective, with as good a five-year cure rate.

When the growth is in the posterior portion of the larynx or where fixation of the cord or subglottic extension or involvement of the aryepiglottic fold or piriform sinus is present, laryngectomy is indicated, followed by x-ray therapy. Laryngectomy is also indicated when the growth tends to grow inward, involving the posterior half of the epiglottis (with x-ray therapy postoperatively); in recurrent cancer of the ventricular band; for growths originating in the piriform sinus (with subsequent x-ray therapy); for growths involving the aryepiglottic fold.

X-ray therapy is the procedure of choice in early carcinoma of the vocal cord; in carcinoma arising in the epiglottis, larger portals being used in order to include channels of lymphatic spread; when extensive extrinsic involvement is found (to be followed by laryngectomy); when metastatic cervical lymph nodes are secondary to primary lesions of the epiglottis or false cords; in carcinoma of the ventricular band (not common).

Block dissection should be done in the presence of metastatic cervical lymph nodes secondary to primary lesions of the vocal cord or subglottic region.

In cancer of the epiglottis where the growth involves the tip, provided the posterior half has not been invaded, the epiglottis may be removed without disturbing the rest of the larynx, either anteriorly through the neck or by suspension laryngoscopy.

STEPHEN N. TAGER, M.D.
Urbana, Ill.

Carcinoma of the Uterus. The Methods and Results of Treatment at the Alfred Hospital Clinic, 1928–1943. J. M. Buchanan. Australian & New Zealand J. Surg. 19: 335–341, May 1950.

In discussing methods and results of treatment of carcinoma of the cervix uteri the author points out the importance of accurate clinical staging, although this is sometimes difficult, and evaluation by experienced examiners often varies. There is a tendency to grade the cancer into a more severe stage than is actually the case because of inflammatory parametrial infiltration. Biopsy should never be omitted, but the author has no confidence in Broders' classification.

Local interstitial radium and implantation of radon seeds have been replaced in the Alfred Hospital (Melbourne) largely by the Paris technic of radium therapy. Thirty milligrams in an intrauterine tube in tandem and 10 mg. in each of two intravaginal corks are left in place for a maximum of 5,500 mg. hr. Occasionally the radium causes a flare-up of an old pelvic infection; if the temperature remains over 101° F. for more than twelve hours, the radium is removed and replaced after four or five weeks.

The author does not place much emphasis on deep x-ray therapy. Following the radium insertion, monthly examinations are made to determine whether further therapy or operation is likely to be required. "Good" cases in Stages I and II are sometimes treated by radical hysterectomy about six weeks following the radium insertion. Operation alone is indicated in cases where dilatation of the cervical canal is extremely difficult and where one runs the risk of perforating the uterus, *e.g.*, in primary endocervical carcinoma.

Total hysterectomy is the procedure of choice in carcinoma of the body of the uterus. Preoperative intra-uterine radium may be used where there is a friable tumor, in order to render operation less hazardous. In poor risk patients intra-uterine radium is applied in two sittings of 3,000 mg. hr. each.

Five tables present the results of treatment of carcinoma of the cervix, carcinoma of the cervical "stump," and carcinoma of the corpus, followed over a five-year period. The survival rate of treated cases of cervical carcinoma in this series is 31.7 per cent. Only 2 out of 13 patients with "stump" carcinoma survived more than five years. The survival rate for 68 cases of carcinoma of the body of the uterus was 38 per cent.

Four illustrations. GABRIEL WHITEMAN, M.D.
Louisville, Ky.

Treatment of Carcinoma of the Cervix. A. N. Arneson. Rocky Mountain M. J. 47: 350–355, May 1950.

In recent years there has been a trend toward surgery in the treatment of cervical carcinoma, one of the indications being the inadequacy of radiation in the control of regional lymph node metastases. The incidence of iliac node involvement in operable patients has been reported by two authors as 33 and 39.3 per cent, respectively, without previous irradiation, whereas following preoperative x-ray therapy their figures are 11 and 23 per cent. If the quantity delivered by external irradiation produced these results, then the much larger total dosage from combined x-ray and radium therapy should result in control of lymphatic dispersions in some instances.

Comparison of the time elapsing between primary treatment and reappearance of the tumor with different

types of therapy indicates that it is quite similar in the reported studies of surgical methods and the author's own experience with radiological methods. There is then very little choice between the two in so far as delay in time of reappearance of tumor is concerned. The location of reappearing tumor seems to be about the same with both methods.

The use of statistical methods for comparison of end-results is inadequate due to lack of uniformity of clinical material. Surgery is usually confined to the very early cases and should be truly radical to be effective. If x-ray and radium treatment are used effectively and intelligently in similar cases, survival rates among very early cases will equal those of surgery and will exceed them in the borderline cases.

The aim of radiation therapy is to deliver an adequate dose to the tumor-bearing region with a minimum of damage to normal tissues. There are practical reasons for giving external x-ray therapy first, and this is the author's practice. The dosage has been varied. Doses of around 200 r (air) per day fail to produce satisfactory tumor degeneration, whereas the patient will rarely tolerate over 400 r (air) per day unless small skin fields are used. Usually 400 r (air) are given daily in succession to four pelvic fields measuring 10 by 15 cm., to a total of 1,600 r per field. Four intravaginal treatments of 1,000 r each are given directly to the cervix. The author has had no five-year cures in Stage IV cases, but believes that a long protracted course of irradiation using multiple small fields may improve results.

The radium dosage is usually divided into two applications—one toward the latter part of the x-ray treatment and one immediately after its conclusion. The aim is to deliver about 5,000 gamma roentgens at a point 2 cm. lateral to the canal and around 1,500 gamma roentgens at a point 5 cm. lateral to the canal, near the pelvic wall. Radium tubes of the same physical size but containing amounts of radium varying from 5 to 40 mg. are used. The amount used in the uterine tandem is determined by the length of the canal, the size of the uterus, and the extent of involvement. The tubes are placed in Raflex tubing of appropriate length. The filtration is 0.5 mm. of platinum. The vaginal applicator is cut from sponge rubber 2.5 cm. thick. The radium tubes are placed in brass shells 1 mm. thick and appropriately spaced in the sponge rubber, which is then inserted and packed into the vaginal fornix, with the tubes at right angles to the axis of the vagina. The time of application averages sixty hours for each of the two periods.

The author's statistical data show 73.3, 54, and 14 per cent five-year survivals for Stages I, II, and III, respectively, but none for Stage IV. For private patients the results are somewhat better than for ward patients.

Four diagrams; 1 photograph; 1 chart.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Carcinoma of the Cervix. A Report of 200 Cases Treated with Radium and X-Rays. George C. Wilkins. New England J. Med. **242:** 895–896, June 8, 1950.

About ten years ago the author published a report of 185 cases of carcinoma of the cervix treated with radium only, during the years 1920 to 1934, with a five-year survival of 37 per cent (New England J. Med. **224:** 414, 1941. Abst. in Radiology **37:** 520, 1941). At this time he reports a second series of 200 consecutive cases treated from 1934 to 1944, but with the addition of preliminary x-ray therapy. The total x-ray dosage is said to have varied from 7,600 to 9,000 r, but no other information as to this phase of the treatment is offered. The five-year survival for the second series was exactly the same as for the first series, namely 37 per cent.

The same method of application and dosage of radium therapy were used in both series of cases, and treatment was given by the same therapist. After the cervix is dilated, 100 mg. of radium, screened with 2 mm. of brass, is placed in the cervical canal (75 mg. in the proximal portion and 25 mg. in the distal portion). This is left in place for twenty hours. Two days later another application of radium in a T-tube, with 50 mg. in the canal and 50 mg. in the cross-arm, is applied for eighteen hours. Three weeks after this, a third and last application is made in the same manner as the first, for eighteen to twenty hours. These applications total 5,600 to 5,800 mg. hours.

The author believes that preliminary x-ray therapy offers a definite advantage in the control of bleeding and vaginal discharge and in preparation for subsequent radium application, though it does not affect the curability of the disease.

JOHN B. MCANENY, M.D.
Johnstown, Penna.

Histologic Changes Produced by Radiation in Adenocarcinomas of the Uterus. Comparison with Changes Produced in Squamous Cell Carcinomas of Cervix. J. F. Sheehan and H. E. Schmitz. Am. J. Clin. Path. **20:** 241–252, March 1950.

The morphologic changes produced by radiation in squamous-cell carcinomas, particularly of the uterine cervix, are well known. The histologic findings have been summarized by Warren (Physiol. Rev. **24:** 225, 1944). In the present report the changes produced by radiation in adenocarcinoma of the uterus are described and compared with those in squamous-cell carcinoma.

As in the authors' earlier study of the effects of gradually increasing doses of 800-kv. roentgen radiation on squamous-cell carcinoma of the cervix (J. A. M. A. **112:** 17, 1939), 2 patients with adenocarcinoma were given a dose of approximately 1,000 r delivered to the mid-pelvis each week for four weeks, in five daily doses, for a total of 4,000 r, and tissue was removed for biopsy at weekly intervals. Eleven other patients with adenocarcinoma of the uterus received radium and/or roentgen therapy (800 kv.) and the uteri were removed at varying intervals after completion of radiotherapy. In some cases, tissue obtained by curettage was also examined. Radium was usually administered in a Y-shaped capsule, introduced with the arms of the Y collapsed. The arms were then separated to lie in contact with the side walls of the body of the uterus.

A sequence of changes was observed which were comparable to those found in irradiated squamous-cell carcinoma. In addition, special effects on glandular structures were noted, such as simplification of glands, loss of glandular form, disintegration of glands, and inspissation of secretion with or without foreign-body giant-cell reaction.

Ten photomicrographs.

The Future in the Treatment of Carcinoma of the Cervix. Malcolm Donaldson. J. Obst. & Gynaec. Brit. Emp. **57:** 411–414, June 1950.

This paper is based largely upon figures appearing in a new report, sponsored by the British Empire Cancer

Committee, the Stockholm Cancer Society, and the Donner Foundation, U.S.A., giving the results obtained in the treatment of carcinoma of the cervix in various institutions (reviewed in Radiology **54:** 888, 1950). The following chart summarizes the average 1949, five-year cure rates for 13,728 patients from 22 centers, in 8 different countries, including the United States.

	No. Cases	Five-year "Cure" Rate
Stage I	1,986	60.9%
II	5,344	42.9%
III	4,660	23.0%
IV	1,736	8.0%
Unclassified	2	

Sixty-nine per cent of all patients treated die within five years, and even with the clinically early cases, 50 per cent die within that period. The chief factor in this failure to cure is early lymphatic spread, associated with radioincurability of the primary lesion. If a method could be found which could pick out the radioincurable lesions in an early stage, then these could more rationally be attacked by radical surgery. The writer believes that such a method exists in the Glucksmann method of cell count. A section is taken before irradiation, and four types of cells are counted—mitotic cells, resting cells, degenerating cells, and differentiating cells—the count for each being expressed as a percentage of the total. The count is repeated seven, fourteen, and possibly twenty-one days after treatment. If the percentage of mitotic and resting cells goes down, and of degenerating and differentiating goes up, the results should be favorable, and *vice versa*. It is believed that the radiocurable carcinomas are distinguished from the others in their inherent capacity to increase the extent and degree of differentiation in response to radiotherapy.

The author thinks, as does this reviewer, that it is unlikely that either radiotherapy or surgery will be the final answer to the cancer problem. Chemotherapy offers the greatest hope. Meanwhile it is important to improve the methods at our disposal.

Six illustrations.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Fever in Association with Radium Therapy in an Otherwise Uncomplicated Case of Cancer of the Cervix. V. Kahanpää. Acta radiol. **33:** 412–420, May 1950. (In German)

A case of cauliflower epithelioma of the portio is presented in which the patient had a fever for four weeks prior to treatment. As no other obvious explanation for the fever was found, it was ascribed to infection of the large growth. Although there was a considerable rise in temperature while the patient was under radium treatment, with a peak of 40.6° C. at the first radium application, treatment was continued. The patient has been objectively and subjectively free of symptoms for five years.

This experience led the author to give active treatment in other cases of uncomplicated cervical carcinoma in which the patient had a fever. The fluctuations in temperature in conjunction with radium therapy were studied in 108 cases. Two curves were constructed showing the average temperatures recorded. In the beginning of the treatment there was a rise of temperature, which began to decline in all cases before the radium applicators and the tamponade were removed. It is concluded that an elevated temperature in itself is no contraindication to radium treatment.

Roentgen Therapy of Bone Metastases Caused by Cancer of the Breast. Its Early Effects and Its Influence upon the Prognosis. Carl Fried. Radiol. clin. **19:** 129–158, May 1950. (In German)

Bone metastases in cancer of the breast are always indicative of a fatal outcome. For palliation, high doses of calcium, vitamin D, sterilization, and administration of sex hormones have been advocated. The author believes that local irradiation is preferable to any of these measures, which exert only a temporary effect.

The frequency of bone metastases in cancer of the breast as reported in the literature varies from 20 to 75 per cent. Reports of the results of radiation therapy of metastatic bone lesions are scarce. Fried found fewer than 100 published cases. To these he adds 37, representing 19.5 per cent of 191 breast cancers.

The majority (89.5 per cent) of the 37 patients had bone metastases within the first three years after surgery. The longest interval was eight years. Bone metastases are more frequent in young women, and the lesions appear earlier than in the older age group. Pelvis and femur are most frequently involved. The majority of the osseous lesions were osteolytic.

The radiation technic is described in detail. For the relief of pain 1,500 to 2,000 r measured in air are sufficient. Tumor doses vary from 3,000 to 5,000 r, depending upon the site and the individual response to irradiation.

Of the 37 patients, 15 survived more than one year. Seven patients were living from one year to five years and three months, an average of two years and eight months. Pain was diminished or eliminated, regeneration of bone was observed, and life was prolonged to an average of 13.4 months. The results depend upon the age of the patient and the grade of malignancy of the primary tumor.

Twenty-four roentgenograms; 9 tables.

EUGENE F. LUTTERBECK, M.D.
Cook County Hospital, Chicago

Irradiation of Lymphoid Tissue in the Nasopharynx: Symposium. Anatomy, Physiology and Pathology of Nasopharyngeal Lymphoid Tissue. Harry P. Schenck. Tr. Am. Acad. Ophth., pp. 479–485, May-June 1950. **Tests for Chronic Eustachian Tube Obstruction.** John R. Lindsay and Henry B. Perlman. Ibid., pp. 486–491. **Indications for and Results of Irradiation in the Nasopharynx.** John E. Bordley. Ibid., pp. 492–495. **Measurements of the Radiation Dose from the Nasopharynx Radium Beta-Gamma-Ray Applicator.** Carl B. Braestrup. Ibid., pp. 496–501. **Potential Biologic Dangers of Nasopharyngeal Beta Irradiation.** Isadore Lampe. Ibid., pp. 502–507. **Nasopharyngeal Irradiation and Hearing Acuity: A Follow-Up Study of Children.** Stacy R. Guild. Ibid., pp. 508–521. **Abuse of Nasopharyngeal Irradiation.** Kenneth M. Day. Ibid., pp. 522–525

The seven articles listed in the title represent a symposium presented at the Fifty-fourth Annual Session of the American Academy of Ophthalmology and Otolaryngology, in October 1949. They are primarily concerned with the use of the nasopharyngeal radium applicator now so widely employed.

The first article describes the anatomy and physiology of the lymphoid tissue and is worth reading in the original. The author emphasizes the role of the lymphoid tissue as the source of immune bodies. Normal dissolution of lymphocytes, which occurs predominantly in lymph nodes after a few hours survival, releases beta and gamma globulin; low doses of radiant energy to lymphoid tissue raise the amount of circulating gamma globulin even in adrenalectomized animals. By destroying lymphocytes, such radiation shrinks nodes, produces lymphopenia, and raises blood protein and the titre of specific antibodies. Excessive destruction of such tissues not only reduces a mechanical barrier to infection and particulate matter but decreases the body's ability to synthesize immune protein.

Lymphoid tissue growth varies with diet, hormonal balance, non-humoral stimuli, infection, and heredity. Inanition causes involution through activation of the pituitary-adrenal cortical mechanism. "The secretion of adrenal cortical hormones, controlled by the pituitary adrenotropic hormones, is the normal mechanism regulating lymph tissue mass." This mechanism is influenced by diverse stimuli such as anoxia, infection, trauma, and heat. Radiation may reduce lymph tissue directly or through stimulating the pituitary adrenal mechanism. Puberal involution of pharyngeal tonsils is manifestly hormonal.

Infection enlarges nodules and nodes and may lead later to atrophy. The description of the pathologic changes in infected nodules should be read in the original: early hyperplasia, the progressive fibroplasia with eventual constriction, the blocking of lymph channels and obliterating endarteritis are the salient points. The influence of radiation in opening channels blocked by proliferated lining is especially interesting.

The second paper describes the clinical diagnosis of tubal obstruction. In preschool children fluid behind the drum implies long-standing block if it persists with the passage of the seasons. Later, distortion and scarring of the drum may occur. In young school-age children, hearing tests are feasible but do not reveal tubal block unless fluid is present. Movement of the normal drum with physiologic pressure changes (Toynbee maneuver) allows an evaluation of normal tubal function in this group. Older children permit more elaborate testing, as with the pneumophone, a device for evaluation of pressure conditions in the middle ear by means of changes of conduction accompanying variable external ear pressure. Auditory tests reveal no characteristic hearing loss for tubal failure; such as do occur are due to negative pressure in the middle ear, to fluid (which results after negative pressure becomes high), and to the development of permanent changes in the conduction mechanism. "Changes in the stiffness, mass and resistance or damping of the conduction mechanism determine in large part what type of hearing loss will be produced in middle ear disease due to tubal failure."

Hearing loss from tubal block without permanent damage is reversible, at least temporarily, by inflation. Failure to reverse the loss on inflation contraindicates therapy of the eustachian tube.

The author emphasizes the difficulty of assessing tubal block from appearances in the nasopharynx.

The third paper, the only one really favorable, in a subdued fashion, to radium therapy of the eustachian tube orifice, outlines carefully the criteria for use of the nasopharyngeal applicator. Where lymphoid hyperplasia has produced chronic or intermittent tubal block with resultant conductive type hearing loss, but in general no middle ear damage, local irradiation may be indicated to shrink the hyperplastic tissue.

The meat of the symposium is found in Braestrup's account of special ionization chamber mensuration of the dosage from the applicator. Surface dose per minute is measured as 370 equivalent roentgens; at 0.5 mm. it is 225 rep; at 1.0 mm., 168 rep; at 2.0 mm., 96 rep.; at 10 mm., 5 rep. Thus, a conventional twelve-minute treatment with the nasopharyngeal applicator in contact, should that condition obtain, would give a surface exposure of 4,450 rep and a 4 mm. depth exposure of 10 per cent.

Data on occupational exposure indicate that the insertion and removal of two applicators (simultaneously) exposes the fingers to one-third the permissible weekly hand exposure. Braestrup also shows the danger of storing the instrument a few feet from personnel. An additional point of interest is that with radium the dose to deeper tissues is greater than with the (old-style) radon applicators because self-absorption of the beta rays in radium requires a greater exposure time. "Past experience with radon can, therefore, not be applied directly to the radium applicator."

The fifth paper by Lampe is essentially a critique of Braestrup's data and a "viewing with alarm" of the complacency regarding the safety of the applicator. Late radiation effects may yet be observed.

The sixth paper, a statistical study from Johns Hopkins, casts doubt on the clinical efficacy of nasopharyngeal radium treatment. Re-examination of a group seen at least six years previously demonstrated that hearing acuity fell slightly (physiologically) for high tones, gained slightly for low tones. A group with high tone impairment who had been treated by "irradiation of nasopharyngeal lymphoid tissue showed an average gain for low tones similar to that in the untreated children in whom it was regarded as normal for the age period and a slight additional loss for the high tones. In no instance of the 52 ears that had an 'abrupt' type of high-tone loss was the highest tone that was well heard of a higher frequency at the last examination than it was at the first examination.

"A group of 24 ears that had a moderate impairment of hearing for all tones—'flat' audiograms at the 25 to 40 db level—had, as a group average, real improvement in hearing acuity for all tones, after irradiation of the nasopharynx. About half of them, however, showed either very little or no improvement of hearing acuity."

A seventh paper again deserves reading in the original. The author doubts the role of hyperplastic lymphoid tissue as a "major cause of tubal obstruction with conductive deafness and high-tone hearing loss." It is a "rarity to find lymphoid tissue actually obstructing the lumen of the eustachian tube." He had observed that "frequently masses of lymphoid tissue impinge on or envelop the tube orifice" when hearing is normal and symptoms are lacking. His remarks are strong with regard to the indiscriminate use of the Monel metal radium applicator. By way of conclusion he includes a photograph illustrating the cutaneous effect of contact exposure: ulceration and necrosis from ten minutes contact.

A discussion concludes the symposium. The reader may be left with many questions and doubts.

Charts and tables.

JAMES A. READ, M.D.
The Henry Ford Hospital

X-Ray Treatment for Peptic Ulcer Does Not Appear to Damage the Heart. Norman E. Goulder, W. J. Carpender, and Erwin Levin. Gastroenterology **15:** 264–270, June 1950.

It is the purpose of the present paper to evaluate by clinical means any possible injuries of the heart that might result from roentgen irradiation of the gastric fundus in supplementary treatment of patients with peptic ulcer. Among more than 800 patients thus treated no instance has yet arisen wherein a direct relationship could be demonstrated between the x-ray therapy and the onset or progression of heart disease.

The present study covers 12 patients, 10 male and 2 female, each of whom was carefully studied with respect to his duodenal ulcer and also his cardiac status prior to the institution of deep x-ray therapy. A daily depth dose of 165 r was delivered to the gastric fundus for a total of 1,650 r, through anterior and posterior portals treated daily. The patient's cardiac status was evaluated on the first day after completion of the irradiation and at two-week intervals for the subsequent six weeks.

Following x-ray therapy, a significant temporary decrease in maximum free acidity in response to histamine was noted in all but 2 patients. In no patient were there symptoms or clinical findings suggestive of disturbed cardiac function. Some definite changes, however, were evident in the serial electrocardiograms taken during the post-irradiation period. These variations were minimal and did not follow any consistent pattern. They comprised: slight changes in the amplitude of the P wave and changes in the amplitude of the components of the ventricular complex.

The authors conclude that the present program of x-ray irradiation of the gastric fundus for the supplementary treatment of peptic ulcer may be safely followed without fear of myocardial damage of clinical significance.

One roentgenogram; 1 serial electrocardiogram; 1 table.

I. MESCHAN, M.D.
University of Arkansas

Physical Aspects of the Roentgen Radiation from a Beryllium Window Tube Operated Over the Range 2–50 K.V.P. for Clinical Purposes. W. A. Jennings. Acta radiol. **33:** 435–484, May 1950.

Previous to the development of the beryllium window tube low-voltage therapy was limited to the 40 to 60 kv. range with the Chaoul and Philips type units. This limitation was due to the structure and characteristics of the tube windows. The development of the beryllium window tube has made it possible to produce the entire range of radiation from grenz rays through the 40 to 60 kv. range with a single tube. Relatively little has been published concerning the physical characteristics of radiation of this quality. Using a tube with 1.0 mm. of beryllium inherent filtration, and with a view toward clinical applications, the author has made an extensive study of the physical properties of radiation over the entire range from 2 to 50 kv.p., with a wide range of filtration, field areas, focal skin distances, and tube currents.

The first part of the paper discusses the difficulties encountered in ionization measurements of very soft radiations at outputs up to 60,000 r per minute. A complete description of the measuring apparatus and the method of calibration over the entire range of qualities and outputs is given. A "tissue-like" wax compound used in the depth dose measurements is described and shown to be of unit density through experimental testing.

The second part of the paper presents the experimental results in measuring the surface dose rates, half value depths, and the 90 per cent absorption depths, and determining how these factors are related to all the relevant variables. The ratio of the 90 per cent absorption depth to the half value depth is then introduced and found to be a variable of practical significance in relation to the half value depth and the surface dose rate. Complete data on the absorption of the radiation in aluminum are given and compared to previously published reports whenever possible. All the above measurements are presented in graphic and tabular form. The information provided has been summarized into a convenient form for routine clinical application for the optimum treatment settings.

Twenty-six graphs; 10 tables; 4 photographs; 1 calibration chart.

DONALD F. MAURITSON, M.D.
Cleveland City Hospital

Comparison of Dosage Distributions Obtainable with 400 kVp X rays and 22-MeV X rays. H. E. Johns, E. K. Darby, T. A. Watson and C. C. Burkell. Brit. J. Radiol. **23:** 290–299, May 1950.

Isodose curves made in a water phantom with 400-kv. x-rays and 22 mev rays (from a betatron) were compared for single and multiple fields. The depth dose was from two to four times greater with the higher voltage. The ratio of integral dose to tumor dose is about 4 times as high for 22 mev as for 400 kv. The isodose curves with the higher voltage are flat, making the distribution more homogeneous. The depth dose with x-rays from the betatron are independent of the size of the field, which simplifies clinical application.

Eleven isodose charts; 1 table.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

RADIOISOTOPES

Use of Radioactive Iodine in the Diagnosis of Hyper- and Hypo-thyroidism. W. F. Perry and J. P. Gemmell. Canad. M. A. J. **62:** 484–490, May 1950.

The amount of protein-bound iodine in plasma is one of the most specific clinical aids in the diagnosis of thyroid disorders. By the use of radioactive iodine the ability of the thyroid to take up iodine or the amount excreted in the urine over a known period of time may be estimated; from this one can calculate an index of the activity of the thyroid gland. The amount of the isotope present in the blood twenty-four hours following administration of a dose may also be taken as a measure of the rate of secretion of thyroid hormone by the gland. However, though methods utilizing radioiodine appear to be even more useful than plasma-bound iodine determinations in diagnosing thyroid disorders, their relative reliability has not yet been assessed. With this in mind, the following study was undertaken to determine the method best suited for clinical use.

The 35 cases studied were divided into 3 clinical

groups, *viz.*, euthyroid, hyperthyroid, and hypothyroid. The euthyroid group consisted of persons whose tissues received the normal amount of thyroid hormone daily, irrespective of the anatomical state of the thyroid gland.

The usual dose of radioactive iodine was 100 microcuries, which was found to be the smallest dose which would give reasonably accurate counts from the plasma aliquots taken for analysis.

The sharpest differentiation between the euthyroid and the dysthyroid subjects was given by the twenty-four uptake of the isotope by the thyroid and by the calculated rates of extrarenal disposal of circulating iodine. These two measurements and the estimation of stable protein-bound plasma iodine correlated very well. The twenty-four-hour uptake separated hypothyroid and euthyroid groups very sharply, as did also the extrarenal disposal rates. The latter values also separated euthyroid from hyperthyroid cases.

The determinations of protein-bound plasma iodine (PBI) provided a good differentiation between the three groups except in 2 cases of thyroid carcinoma. The concentration of radioactive PBI also showed striking differences between euthyroid and hyperthyroid groups. The concentration of radioactive protein-bound plasma iodine was found to be greater in hyperthyroid subjects whether examined after twenty-four, forty-eight, or seventy-two hours. However, hypothyroid subjects had concentrations comparable to the euthyroid group.

One graph; 3 tables.

HARVEY J. THOMPSON, JR., M.D.
Jefferson Medical College

Hypothyroidism Produced by Radioactive Iodine (I^{131}) in the Treatment of Euthyroid Patients with Angina Pectoris and Congestive Heart Failure. Early Results in Various Types of Cardiovascular Diseases and Associated Pathologic States. Herrman L. Blumgart, A. Stone Freedberg, and George S. Kurland. Circulation **1:** 1105–1141, May 1950.

Previous studies have proved that the work of the heart is lessened in hypothyroidism. This has led to the use of total thyroidectomy and antithyroid drugs to induce hypothyroidism in patients with intractable angina pectoris and/or congestive heart failure. The authors' report concerns a group of 18 euthyroid patients with these conditions, who were treated with radioactive iodine (I^{131}).

Each patient received orally a total of 25.5 to 150 millicuries. The average total dose was 54.4 millicuries and the average amount retained within the body during the following seventy-two hours was 17.9 millicuries. The largest single dose given was 56 millicuries. In two-thirds of the patients a transitory thyroiditis developed one to fourteen days following the initial therapeutic dose. Radiation sickness was not observed. Repeated blood and urine examinations revealed no toxic effects.

Following administration of I^{131}, hypothyroidism appeared after five weeks to five months. Some patients were definitely worse during the "thyroiditis" phase. As clinical improvement became evident, it was generally proportional to the degree of hypothyroidism. After the induction of myxedema, small doses of 6 to 100 mg. of thyroid were administered daily to maintain a basal metabolic rate of −15 to −25 per cent, at which level the patients experienced the least discomfort from myxedema and the maximum relief from their cardiac symptoms.

With this regime angina pectoris was strikingly lessened or abolished in 8 of the 13 patients with intractable pain.

Five of 18 patients were incapacitated primarily because of congestive heart failure. Three of these showed worth-while improvement following treatment. Several of the patients in the angina pectoris group also had manifestations of congestive failure which improved as the angina pectoris was relieved.

The authors believe that the procedure has many obvious advantages over surgical removal of the thyroid in this group of patients, but they warn that it should still be considered in the investigative stage.

A dose of approximately 40 millicuries was usually effective in producing myxedema. The most recently treated patients were given two to three doses of 20 millicuries at ten- to fourteen-day intervals. This divided-dose technic was devised in an effort to avoid thyroiditis.

Detailed histories of the 18 cases are included.

Two charts; 3 tables.

C. R. PERRYMAN, M.D.
Baton Rouge, La.

Studies on Lymphocytes from Persons Treated with Radioactive Iodine. William E. Watts and Don R. Mathieson. J. Lab. & Clin. Med. **35:** 885–889, June 1950.

When phase microscopy or supravital staining is used, 34 per cent of normal lymphocytes of human beings are found to contain 1 to 8 refractile cytoplasmic granules. In 1947 Dickie and Hempelmann (J. Lab. & Clin. Med. **32:** 1045, 1947. Abst. in Radiology **51:** 293, 1948) reported striking increases in the lymphocytes of persons who had been exposed to ionizing radiation. Despite the potential importance of this observation confirmatory or contradictory reports have not been seen.

To determine whether or not the number and frequency of refractile cytoplasmic granules increases on exposure of the host to ionized radiation, the authors studied samples of blood from the capillaries of 2 patients with cancer of the thyroid, from 8 patients with exophthalmic goiter before the administration of therapeutic doses of radioactive iodine and at varying intervals thereafter, from 3 technicians who had been exposed to irradiation for from eight to twenty-seven years, and from 4 patients who were receiving massive doses of roentgen rays in treatment for malignant tumors. Control studies were made on blood from normal persons and from patients with various other diseases. No change in the number or frequency of the granules in the lymphocytes was found following exposures to radiation. A search was made for other concise or specific qualitative cytologic effects of irradiation, but none was discovered. The refractile granules were best studied in fresh, unstained preparations by phase microscopy.

Three tables.

Histological Changes Produced by a Single Large Injection of Radioactive Phosphorus (P^{32}) in Albino Rats and in C_3H Mice. B. Grad and C. E. Stevens. Cancer Research **10:** 289–296, May 1950.

Twenty-two normal young male and female albino rats and 8 adult female C_3H mice bearing mammary tumors were injected subcutaneously with a single

large dose of radiophosphorus (P^{32}) and were sacrificed from two hours to nine days later.

The histologic changes were very similar to those produced by intense treatment with x-rays, consisting mostly of pyknosis and karyorrhexis of mitotic nuclei and enlargement of metabolic nuclei. The cytoplasm of damaged cells showed vacuolation and reduced staining ability.

The destructive effects of P^{32} were most marked in lymphatic organs and bone marrow, small intestine, granulosa of ovarian follicles, and mammary tumors.

In the crypts of the small intestine, massive degeneration and pyknosis of dividing cells resulted in thinning of the epithelium of crypts and villi, probably because no new cells were supplied from the crypts to balance the continual loss of cells by extrusion normally occurring at villi tips.

The mammary tumors showed many scattered pyknotic cells at twenty-four hours after injection. At forty-eight hours, large blood lakes had formed without much tissue damage. At nine days, most of the tumor was necrotic and liquefied.

Lesser changes were noted in stomach and colon, in the seminiferous tubules of testis, and in the hair follicles.

Little or no damage was observed in salivary glands, pancreas, liver, genito-urinary system, endocrine glands (except the ovary), brain, muscular and connective tissue.

The experiments with P^{32} reported here suggest that the changes observed in the gastro-intestinal tract, mammary tumors, ovary, hair follicles, and bone marrow were due to a direct impact of the rays, as these structures are among those with the highest concentration of P^{32} in the body. It is also known that these tissues have a high mitotic rate, which may render them particularly sensitive to ionizing radiations.

On the other hand, the lesions of the thymus and lymphatic system may be due to a non-specific reaction such as is observed in many types of stress resulting in a release of adrenal hormone, which then acts upon the thymicolymphatic system.

Thirteen illustrations; 1 table.

Studies on the Hazard Involved in the Use of C^{14}. II. The Effect of a Single Dose of C^{14}-labeled Sodium Bicarbonate on the Pattern of Deaths from Spontaneous Leukemia in Akm Mice. Howard E. Skipper Martelia J. Bell, and Juanita B. Chapman. Cancer Research **10:** 362–363, June 1950.

Leukemia-susceptible Akm mice were injected with carbon 14-labeled sodium bicarbonate at the rate of 18 μc. per mouse (equivalent to a dose of about 50 mc. for a 70-kg. man on a weight basis). This dose had no significant effect on the pattern of deaths from leukemia in this highly susceptible strain of animals.

Two tables.

Use of Radioactive Isotopes in Study of Fungi and Bacteria. J. M. Hammer, I. A. Pearson, K. E. Corrigan, H. S. Hayden, and W. L. Mallmann. Am. J. Clin. Path. **20:** 282–286, March 1950.

It has been demonstrated that the spores of fungi both pathogenic and non-pathogenic, can be made radioactive. In previous work the authors found it essential, first, to handle fungus cultures as rapidly as possible to protect the worker from undue exposure to harmful radiations, and second, to retain the spores in the culture tube and not allow them to escape into the surrounding air of the laboratory, thus preventing a hazardous condition for all personnel in the immediate vicinity. The method of transfer used routinely in most laboratories does not meet these requirements, and an improved technic has been devised by the authors. It consists of adding fluids to cultures in order to wet the spores and disperse them into the solution rather than into the surrounding air.

A technic for making autoradiographs of microorganisms is also described.

Three illustrations.

EFFECTS OF RADIATION

Radiation Sequelae and Their Treatment. Arthur R. Woodburne and Kenneth C. Sawyer. Rocky Mt. M. J. **47:** 265–268, April 1950.

The fundamental damage from radiation is to the vascular supply, with temporary or permanent loss of adequate nutrition, and treatment must be based on this premise. The authors recommend the following measures:

For acute radiodermatitis, compresses of saline or boric acid are indicated. Beyond this only the simplest of emollients should be used, as cold cream or a bland oily lotion. In deeper areas, or those showing infection or severe edema, aloe vera cream or chlorophyll used as a wet dressing, or in an ointment, may be soothing. In deep ulcers, topical anesthetics may be tried for the pain, but cool compresses and mild emollients have given better results. Thorium-X and ultraviolet light have not been found helpful.

Atrophic areas should be protected from the sun, wind, and chemical or other physical irritations. Iron or other organic pigments incorporated in a base of equal parts of ointment of zinc oxide and Lassar's paste proportioned to match the skin color will make a protective paste. Covermark is occasionally used. Phenyl salicylate added to simple creams will exclude actinic rays. Para-amino-benzoic acid in 10 to 15 per cent strengths is also helpful.

Areas of hyperkeratosis should be excised or destroyed electrosurgically. Radiation therapy is contraindicated in the treatment of malignant changes in radiodermatitis.

[The authors' lack of specificity as to their therapeutic regimens points up the paucity of real therapeutic knowledge in this field.—M. R. C.]

Six illustrations. MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Role of the Spleen in Radiation Injury and Recovery. L. O. Jacobson, E. L. Simmons, E. K. Marks, M. J. Robson, W. F. Bethard, and E. O. Gaston. J. Lab. & Clin. Med. **35:** 746–770, May 1950.

This communication compares the effect of 1,025 r on the blood and blood-forming tissue in mice with and without lead protection of the surgically mobilized spleen during irradiation. Four groups of CF-1 female mice, ten to twelve weeks of age, were used for the

study. The animals in Group I served as controls. Those in the other three groups were anesthetized with nembutal and the spleens more mobilized through a left upper quadrant incision with the main pedicle intact. The mice in Group II received no irradiation. Mice in Groups III and IV were given a dose of 1,025 r whole body x-radiation but during irradiation the spleens of the mice in Group IV were protected by a lead chamber, which reduced the dose to the spleen to a negligible amount. The spleens of the mice in Group III were wrapped in sterile gauze or placed in a paraffin box which offered no appreciable shielding from irradiation.

A severe anemia, leukopenia, thrombocytopenia, and reticulocytopenia occurred in the mice without lead protection of the spleens. No animals thus exposed survived beyond the thirteenth day. No significant anemia and only a transient leukopenia and thrombocytopenia occurred in the mice whose spleens were mobilized and lead-protected during irradiation. Forty-two per cent of these mice survived beyond the twenty-eight days of observation.

The lymphatic tissues (thymuses, lymph nodes, and spleens) of mice *without lead protection of the spleen* during irradiation were reduced to a reticulum stroma, and no recovery was apparent during the thirteen days of observation. The lymphatic tissues of mice *with lead protection of the spleen* during irradiation never became depleted of free cells and resumed an essentially normal cellularity by the seventh or eighth day after irradiation. Ectopic erythrocytopoiesis and granulocytopoiesis were increased remarkably in these lymphatic tissues by the eighth day after irradiation.

Hematopoiesis in the bone marrow of mice *without lead protection of the spleen* during irradiation was destroyed; the bone marrow remained thus depopulated through the tenth day after irradiation, and only beginning regeneration was apparent on the eleventh day after irradiation. Atypical fibrous tissue involving chiefly the metaphysis and epiphysis, but occasionally involving the diaphysis as well, was prominent at all intervals of study from the fourth day.

The bone marrow of mice *with lead protection of the spleen* during irradiation was never depleted of free hematopoietic cells and was normal in cellularity at seven or eight days and hyperplastic thereafter. Atypical fibrous tissue was inconspicuous in the bone marrow of this group.

A marked increase in ectopic blood formation in the lead-protected spleen of the animals given 1,025 r whole body x-radiation occurred. This increase was steady through five to six days. The initial increase was largely erythroblastic but, beginning between the fourth and sixth days, an increase in megakaryocytic and granulocytic precursors was found. Concurrent with increased ectopic erythrocytopoiesis in the spleen, the splenic white pulp decreased in amount.

Undoubtedly, the rapid development of ectopic blood formation in the lead-protected spleen and the early recovery of the bone marrow and lymphatic tissues accounts for the fact that no anemia and only a modest and transient leukopenia and thrombocytopenia occurred.

The mean weight of mice irradiated with spleen protection and of mice irradiated without spleen protection fell more or less equally during the first five days following exposure. Thereafter, the mean weight of the mice without protection continued to fall until death occurred, whereas in the mice whose spleens were protected the weight was normal again by the eighteenth day.

Fourteen figures.

Studies of Electrophoretic Serum Protein Patterns in Subjects Treated with Pituitary-Adrenal Cortical Hormone, Nitrogen Mustard, or X-Radiation. Julian Frieden and Abraham White. Yale J. Biol. & Med. **22:** 395–406, May 1950.

The authors' investigations were preceded by discoveries by others, during the previous ten years, indicating that stimulation of the pituitary-adrenalin cortical secretions causes a decrease in lymphoid tissue and a blood lymphocytopenia with a subsequent elevation of antibody globulins by dissolution of a protein in the lymphocyte identical with serum antibodies found in beta- and gamma-globulin fractions of blood.

With this experimental background a study was made of the serum protein patterns, as measured by electrophoresis rather than by chemical methods, in both dogs and human beings receiving either ACTH, cortisone, or x-radiation as agents producing dissolution of lymphocytes, or drugs such as nitrogen mustards producing lack of lymphocytic formation.

The conclusions are: (1) Single injections of ACTH or adrenal cortical extract produced no significant change in serum protein level. (2) X-radiation of cancer patients likewise produced no consistent change in serum protein level. (3) Nitrogen mustard, despite pronounced involution of body lymphoid tissue, did not alter the serum proteins.

Four tables.

E. H. PRICE, M.D.
Indiana University

Attempt to Detect a Mammary Tumor-Agent in Strain C Mice by X-Radiation. Howard B. Andervont and Thelma B. Dunn. J. Nat. Cancer Inst. **10:** 1157–1189, April 1950.

The experiment reported here was one of a series of investigations which had, as its primary objective, the demonstration of the mammary tumor-agent in low-mammary tumor-strain-C female mice. An attempt was made to enhance the activity of the agent or to decrease the resistance of the animals by exposing newborn strain-C females to whole-body x-irradiation. Relatively small doses (25 to 200 r) of x-radiation were given, because it was essential to procure litters from the irradiated mice. The C females were bred to strain-C_3H males because F_1 hybrids derived from these strains were known to show a high incidence of mammary tumors at a late average age. It was expected that, if irradiation of the strain-C females increased the activity or amount of agent in them, this increase would be reflected in a higher incidence of mammary tumors at an earlier average age in their F_1 hybrid offspring.

The over-all results indicated that the procedure did not influence the activity of the agent, since the incidence of mammary tumors in offspring of non-irradiated C females was the same as in those derived from irradiated animals.

Fifteen photomicrographs; 4 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Differential Radiosensitivity of Haploid and Diploid Prepupae and Pupae of Habrobracon. A. M. Clark and E. M. Kelly. Cancer Research **10:** 348–352, June 1950.

Habrobracon prepupae and pupae were exposed to x-radiation, and the lethal effects of the radiation were studied. The x-rays were shown to have a greater lethal effect upon haploid males than upon diploid males or diploid females. Diploid males and diploid females proved equally susceptible. Prepupae were more sensitive than pupae.

No significant difference was observed in adults given the same total dose but at different intensities. The response, therefore, seems to be independent of intensity.

Comparison of adults developing from irradiated prepupae and pupae shows that a greater number of haploid males show structural malformations than do diploids, irrespective of sex, and that the haploids show these malformations to a greater degree. Comparison of individuals unable to emerge from cocoons shows that the diploids are in general more advanced in their development than are the haploids.

The evidence obtained that diploids are more resistant than haploids to the lethal action of x-rays suggests that the number of chromosome sets is a factor in determining the radiosensitivity of cells.

Two tables.

Studies on the Effects in Vitro of Roentgen Radiation on the Biological Activity of the Agent of Chicken Tumor I (Rous Sarcoma). W. Ray Bryan, Egon Lorenz and John B. Moloney. J. Nat. Cancer Inst. **10:** 1215–1237, June 1950.

The curve relating dosage of roentgen rays or other ionizing radiation to the surviving activity in irradiated samples of biologically active agents, such as bacteria, viruses, and enzymes, may be of value in determining certain of their physical and chemical properties.

The virus-like agent of chicken tumor I has been shown to be associated with the so-called microsome constituents of tumor tissue extracts, but all attempts to isolate it in pure form have thus far proved unsuccessful. The present investigation was for the purpose of determining whether the dose-survival curve for the agent of chicken tumor I irradiated with x-rays would differ appreciably in studies carried out with different types of impure and partially purified suspensions of the agent. Six experiments were done with quantitative bioassay technics.

The characteristics of the dose-survival curve were found to vary with the method of preparation, and with the relative "purity," of the tumor-agent suspension subjected to irradiation. The suspensions investigated ranged from crude extracts of tumor tissue to a microsome fraction which had been separated and partially "purified" by 2 cycles of differential centrifugation.

The diameter of the radiosensitive structure of unit particles of chicken tumor I agent is estimated from the best results of this series of experiments to be 46 to 49 millimicrons. The possible implications of this finding with respect to internal structure of the unit particles are discussed.

Evidence is presented that aggregation of constituents of the microsome fraction with which the active tumor agent is associated may be responsible, at least in part, for the variations among dose-survival curves observed in the different experiments.

Six figures, 6 tables.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic

Effect of X-Radiations on Squid Larval Tropisms. Roberts Rugh. Biol. Bull. **98:** 247–253, June 1950.

In the squid larva the eyes are among the first organs to differentiate, and squid embryos manifest positive phototropism and negative geotropism long before the time of hatching. These tropisms can be rather accurately measured. The author reports the effect of various x-radiation exposures on these sensory responses of the squid embryo. The strong phototropistic response of recently hatched squid larvae is immediately nullified in many specimens following x-irradiation to 10,000 r, but 100,000 r completely nullifies this response in all larvae, although they remain motile. The strong negative geotropism of the squid larva is immediately reduced by 50,000 r and completely nullified by 100,000 r. This effect is also immediate, but the larvae remain motile. Growth of squid larvae is stopped immediately by x-irradiation to 5,000 r or more, but no dose used (up to 200,000 r) had any immediate effect on the functioning of the smooth muscles, so that the motility of the organism as a whole was unaffected. The chromatophores and eyes remained the size they were at the time of irradiation.

Two plates, including 16 sections of the eye.

DONALD S. CHILDS, JR., M.D.
The Mayo Clinic